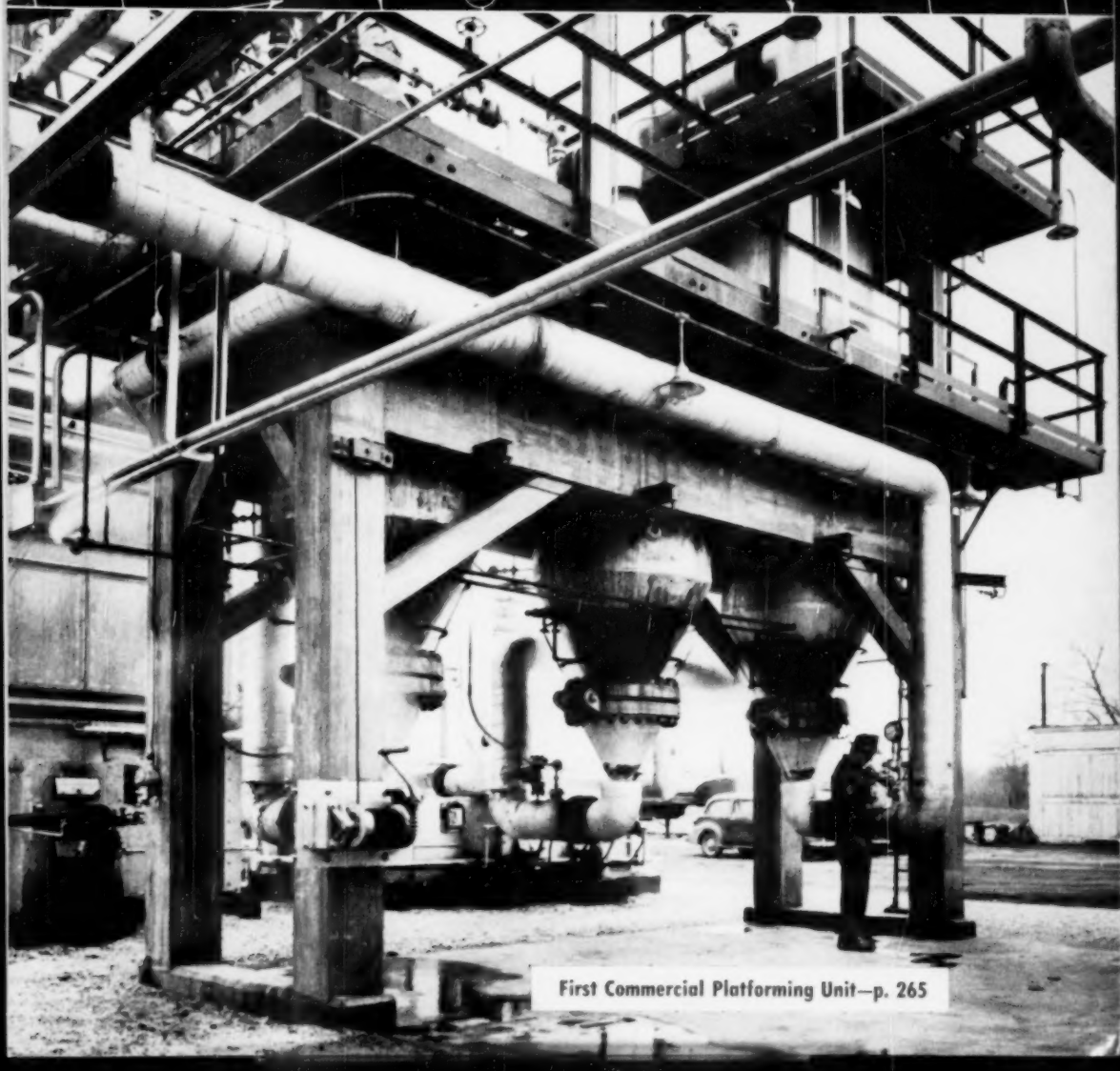
MARCH, 1950
VOL. 5, NO. 3

PETROLEUM PROCESSING



First Commercial Platforming Unit—p. 265

HUDSON DIRECTAIRE UNITS

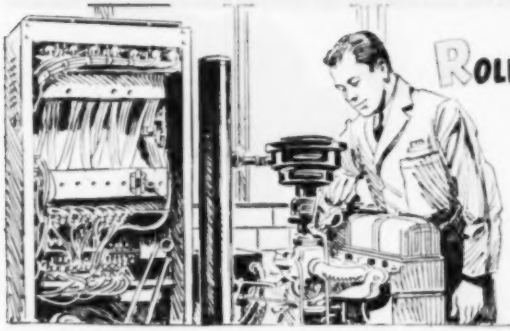
Hudson DIRECTAIRE units are now transferring more than 500,000,000 BTU per hour of process heat from steam, gas, jacket water, hot oil and hydrocarbon vapors DIRECTLY TO THE AIR, obviating the use of water as an intermediate transfer medium. Gears, driveshafts, fans, finned tube surface and structural steel supporting frame work which make up the Hudson DIRECTAIRE units are selected and designed for long life in continuous outdoor service. Drivers may be electric motors, steam turbines, gas engines, or hydraulic motors. DIRECTAIRE units are manufactured and assembled in the recently completed Hudson plant at Houston. The Hudson organization welcomes the opportunity of studying your overall heat dissipation problem. Such studies will enable you to make the most advantageous selections of cooling equipment for the particular problem, whether Cooling Towers with water cooled units; or DIRECTAIRE units, or combinations of the two.

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION HOUSTON, TEXAS

BATTERY OF TWELVE HUDSON *DIRECTAIRE* UNITS
COOLING HOT OIL AND GAS AND CONDENSING STEAM AND
HYDROCARBON VAPORS IN A TEXAS GAS PROCESSING PLANT

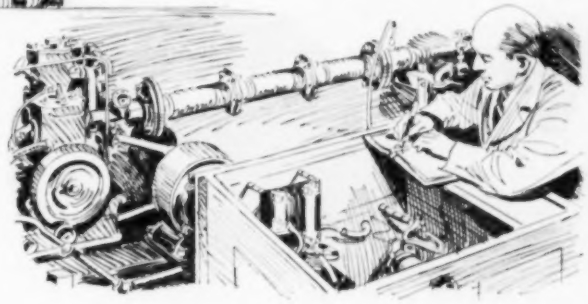
Designers and Constructors of { GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • FRACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE MAINTENANCE PLANTS • HYDROGEN SULPHIDE REMOVAL PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

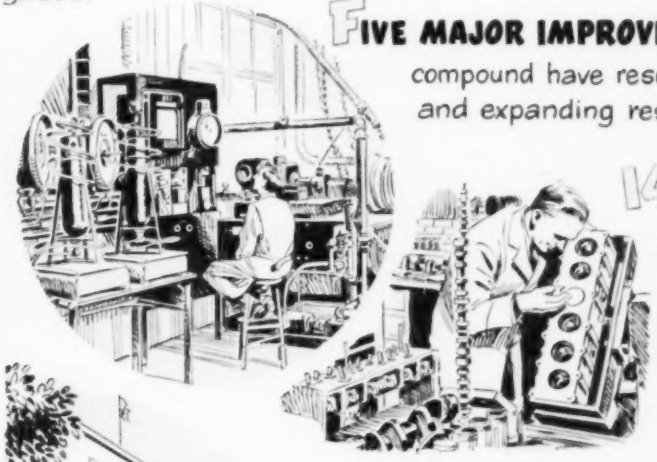
Technically Speaking... by ETHYL



ROLLED-UP HIGHWAY. This special Ethyl equipment-designed on the principle of a **PLAYER PIANO**—uses a perforated tape to control engine speed and torque... simulating indoors the variations found in road service.

TRAPPING THE INVISIBLE. In the development of antiknock compounds Ethyl uses a Cottrell precipitator to trap all solid particles--many of them invisible--in engine exhaust gases.



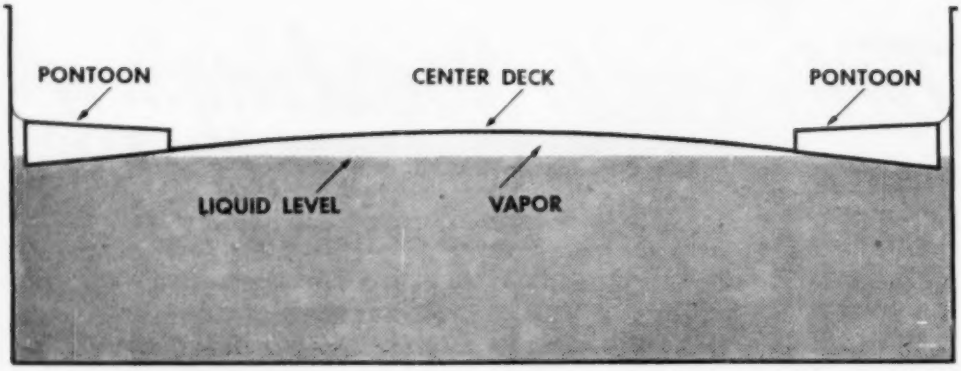


FIVE MAJOR IMPROVEMENTS in "Ethyl" antiknock compound have resulted from Ethyl's intensive and expanding research program.

146 "CLEANLINESS" RATINGS are made on 83 engine parts after each test run... in research to show the effects of different fuels, lubricants, and additives on engine cleanliness.

Since 1923—*continuous research to provide better antiknock service*

ETHYL CORPORATION
RESEARCH LABORATORIES
Detroit, Michigan, 1600 West Eight Mile Road • San Bernardino, California, 2600 Cajon Road



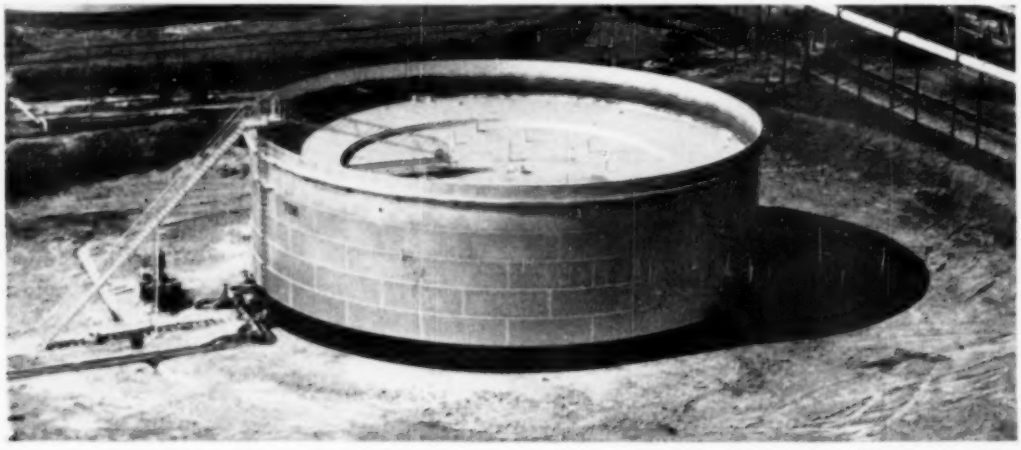
Here's How the HORTON® Pontoon Roof Provides Protection Against Boiling Losses

The above sketch shows how the Horton Pontoon Roof gives you effective protection from evaporation losses due to boiling when it is installed in a flat-bottom tank storing crude oil, gasoline or similar petroleum products. The air space in the pontoon ring around the outer edge of the deck insulates the seal and the liquid under it. If boiling occurs, the vapor forming throughout the body of the liquid rises to the top. There is it trapped under the single deck which bulges upward slightly. The blanket of vapor between the surface of the liquid and the center part of the Horton Pontoon Floating Roof serves as an effective insulating medium and gradually reduces the amount of boiling that takes place in the tank.

Normally the entire bottom of the Horton Pontoon Roof rides directly on the liquid in the tank. The only time there is a vapor space underneath it is when boiling occurs.

Protection from evaporation losses caused by boiling is only one benefit provided by this outstanding design of floating roof. It also cuts down corrosion, decreases the fire hazard, and reduces breathing and filling losses. Write our nearest office for full details.

Below: 37,500-bbl. tank equipped with a Horton Pontoon Roof at the Esso Standard Oil Company refinery at Baton Rouge, La. This aerial view shows the pontoon and single deck sections clearly.



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[To obtain more data on advertised products see page 296]

PETROLEUM PROCESSING

Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals

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VOL. 5, No. 3 MARCH, 1950

Contents

FEATURE ARTICLES

"Variables" Growing in Importance as Factors in Product Demand, *from a report by Jerry A. Cogan* 241
Electrical Control of Air Line Burners in Thermofor Catalytic Cracking Unit, *by John M. Crothers* 243
Pure Oil's First Solvent Lube Plant Now in Operation at Smiths Bluff, *by D. P. Thornton, Jr.* 245
Economic Handling of Caustic Soda With Variable-Area Flow Meters, *by Arthur Patureau* 248
CORROSION—Damage to Interior of Vessel Walls From Hydrogen Blistering Studied, *A Staff Report* 253
Topography Figured in the Design of New Montana Refinery, *by D. P. Thornton, Jr.* 256
Increase Width of Inlet Chamber in New Waste Water Separator, *by J. S. Baum* 261
Strategy for True Liberals, *by Robert E. Wilson* 263
Details on Platforming Process Scheduled for WPRA Meeting 265
Ethylene Production by Cracking of Propane-Ethane Mixtures, *by C. K. Buell and L. J. Weber* 266

DEPARTMENTS

What's Happening! 215
Tomorrow in Petroleum Technology, *by B. H. Weil* 219
Plant Practices, Practical Tips and Ideas 273
Laboratory Practices 276
Patent Trends in Petroleum Refining, *by Peter J. Gaylor* 279
Gasoline and Cycling Plant Operation, *by Dave Thornton* 283
Equipment Patent Review 286
Refining Trends—Current Statistics 289
News of Manufacturers—Suppliers—Engineering Firms 293
Advertiser's Index 296
What's New! Equipment, Material, Processes, Literature 297
Personals 310
Meetings for the Oil Man 311
Editorial Viewpoints 312

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PLATT'S OILGRAM NEWS
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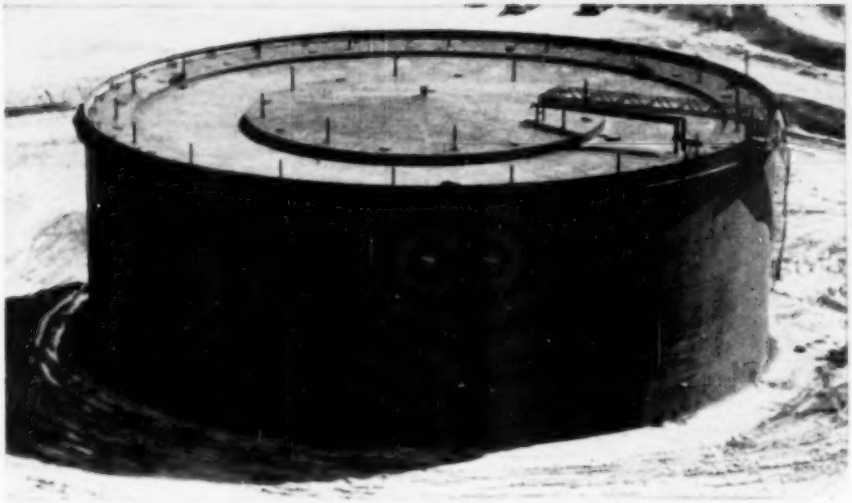
NATIONAL PETROLEUM NEWS
The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

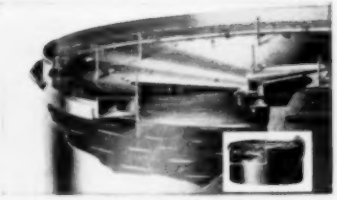
PLATT'S OILGRAM PRICES
A daily independent oil-price reporting service issued from New York, Cleveland, Houston

Exclusive features mean bigger savings



Floats on the liquid and seals the liquid surface with the aid of a vapor-tight closure. Rises and falls with changes in volume. Permits vapors to expand without venting. Prevents losses during refining, transportation and marketing. Saves vapors when unseasonable crudes and products are stored.

Only genuine Wiggins Floating Roofs give you triple seal protection! 75% of "full tank" evaporation losses are eliminated. Retains 50% of the vapors lost by tanks with only single seals. Has the much-copied long limber shoe originated by John H. Wiggins to assure positive, constant contact with the tank shell. Very low maintenance cost—steep deck assures rapid drainage.



Wiggins Hidek Floating Roof

Wiggins Lodek Floating Roof

Wiggins FLOATING ROOFS
Typical Average Pay-Out
18 MONTHS

ASK FOR A "PAY-OUT" ANALYSIS OF YOUR STORAGE SET-UP. NO OBLIGATION.
GENERAL AMERICAN ENGINEERS ARE EXPERTS AT REDUCING VAPOR LOSSES.

Wiggins Conservation Structures

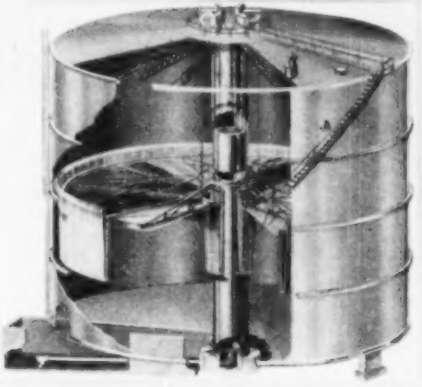
. . . more rapid pay-out!

Wiggins
DRY SEAL LIFTER ROOF
Typical Average Pay-Out
11½ MONTHS

Wiggins Dry Seal Lifter Roof

The economical way to conserve the vapors of a single tank or two interconnected cone roof tanks. The roof is supported by confined vapor, rising and falling as the volume changes. Has a patented dry seal to prevent vapor from escaping. Internal pressure exceeding 1¼" of water causes roof to lift. Maximum roof lift is 10 feet. Balancing system keeps roof level even under eccentric load conditions produced by wind or snow.

Wiggins
DRY SEAL GASHOLDER
Typical Average Pay-Out
20 MONTHS



Wiggins Dry Seal Gasholder interconnects at standard working pressure with all cone roof tanks for a complete vapor balancing system.

WIGGINS VAPOR SEALS GENERAL AMERICAN TRADE MARK

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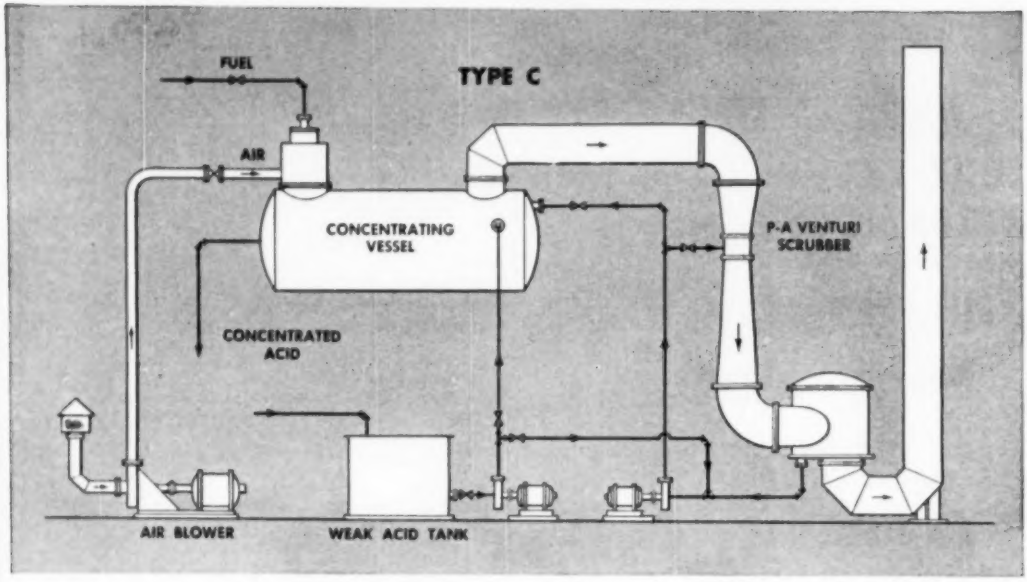
Turns breathing and pumping losses into profits! The 100% dry seal, which has a life equal to that of the tank, eliminates "wet seal" corrosion problems—requires no heating system during freezing weather. No fire hazard. Has low initial cost—low upkeep. Attention, adjustment or lubrication not needed.

. . . by General American

Chemico Announces

NEW HIGH TEMPERATURE CONCENTRATOR

for spent sulfuric and phosphoric acids



THE NEW TYPE C High Temperature Acid Concentrator is a major improvement on the well known Chemico Drum Type Concentrator. This new unit is specially designed for concentrating spent sulfuric acid from petroleum refining, alcohol synthesis and nitrating operations as well as phosphoric acid from triple superphosphate operations.

The Type C unit employs the same principle as the Drum Type. Hot combustion gas is released under the surface of the acid where it gives up most of its heat and emerges at a temperature slightly above that of the acid itself. The combustion of the fuel takes place in the dip pipe, which withstands a high temperature on the *inside* and the corrosive action of acid on the *outside*.

But the new Type C Concentrator uses combustion gas at 2500F instead of 1100F. This high-temperature operation provides greatly improved heat efficiency. It also produces a much smaller volume of gas to be scrubbed at the concentrator exit. Here Chemico utilizes the recently developed and highly efficient P-A (Pease-Anthony) Venturi Scrubber which eliminates up to 99% of acid mist.

SEND FOR CHEMICO BULLETIN S-112, which fully describes this new Type C unit as well as the Type S Concentrator for acids containing soluble salts.

ADVANTAGES OF THIS NEW CHEMICO UNIT

1. Use of high temperature combustion gas assures high heat efficiency.
2. Retains the best features of the Chemico Drum Type Concentrator.
3. Low initial investment.
4. Low operating cost.
5. Low maintenance cost.
6. Acid concentration through all ranges of strength up to 96%.
7. High acid recovery.
8. Built-in fume eliminator (P-A Venturi Scrubber).
9. Specially adapted for use on acids containing salts as, for example, waste pickling solutions.
10. No heat transfer surfaces to cake up.
11. Fully guaranteed by Chemical Construction Corporation who have more than 35 years of experience in this field and a background of more than 200 successful concentrating unit installations.

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Chemico Plants are Profitable Investments

[*To obtain more data on advertised products see page 296*]

What's Happening!

Important Current News Summarized for Refiners

EXPANSION

British American Oil Co. will build a new refinery at Edmonton, Alberta, with a charge capacity of nearly 6000 b/d. Included in the facilities will be combination crude oil distillation and thermal cracking, coking, fluid catalytic cracking, and a complete chemical treating plant. Contract for engineering and construction has been awarded to Canadian Kellogg Co., Ltd., subsidiary of M. W. Kellogg Co.

The new refinery will process crude from Redwater, which is to be brought to the refinery by pipeline. With the completion of this new plant, British American will have three western refineries with a total capacity of close to 20,000 b/d all operating on western Canadian crude.

Imperial Oil Co. has also selected Canadian Kellogg to handle the engineering and construction of its new refinery, announced last month, at Winnipeg, Manitoba. Additional details now available indicate that the plant will have 12,000 b/d capacity, instead of the 10,000 b/d originally announced, and will include atmospheric and vacuum crude distillation, and Fluid catalytic cracking.

Fullerton Oil Co., Snyder, Texas, has awarded contract to Hudson Engineering Corp., Houston, for immediate erection of a refrigeration-type natural gasoline plant in Kelly pool, Scurry County. The plant, the first in new and rapidly developing Scurry field, will have a capacity of 40 million cu. ft. daily, and is scheduled for completion in July.

Other new plants in Scurry County which are in the wind: Standard Oil Co. of Texas is planning a 30 million cu. ft. high pressure-type plant in the North Snyder field. Lion Oil Co. reportedly is designing a 40 million cu. ft. plant to serve the Diamond M and Sharon Ridge pools. Barnsdall Oil Co. is planning to build and run a 26 million cu. ft. plant for several co-owners.

Gas in the field is quite rich in liquid hydrocarbons, some reports assaying more than 6 gal. per Mcf.

• • •

FOREIGN

Creole Petroleum Corp. has started operating the atmospheric distillation unit at its new 60,000 b/d refinery at Amuay Bay, Venezuela. The unit went on stream Jan. 3, and is running at approximately full capacity. The vacuum unit, to complete the plant, is expected to start operation next fall.

Phillips Oil Co., subsidiary of Phillips Petroleum Co., will build and operate a modern refinery and wax plant in eastern Venezuela in compliance with its oil concession contracts. Production is expected to exceed 2 million bbls. of high grade wax annually. Although wax will be the principal product, the plant will also make some gasoline, kerosine and fuel oils. Construction is expected to begin in 1951, operation in 1952. All wax now consumed in the country is imported. Phillips has 6500 b/d crude production in the San Roque field from 11 wells, with 5 more underway.

Funds earmarked for aid to Britain in construction of Shell Haven oil refinery near London have been reduced by Economic Co-operation Administration from $10,043,000 to $2,455,000. Cutback was made, ECA said, in accordance with revised British plan to reduce over-all cost of refinery from $58,400,000 to about $34,000,000 and to decrease capacity from 66,000 b/d to 40,000 b/d. Catalytic cracking has been eliminated in the revised plan, also.

• • •

MARKETS, PRICES

February was a month of some contraction for the industry. The rate of manufacturing declined in refining centers, and the tendency of crude oil allowables continued downward.

The nation had amassed a peak inventory load of gasoline, more than 131 million bbls. The result was that all grades were under some downward price pressure.

There was a severe drop in prices for natural gasoline. Otherwise, distillate prices tended somewhat higher in the Midwest and lower along the Atlantic seaboard. Wax prices and solvent lubricating oils mostly were unchanged.

Gasoline price wars flared up at the service station level in some areas of the country. Mostly, however, the cuts reflected the fact that distributors were willing to take a lower margin to get more gallonage. Cargo traders at the Gulf said prices for "quality" regular and premium gasoline were "extremely

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

steady" considering the season and the amount of supply on hand.

Spots affected most in price wars on gasoline, where cuts ranged from 2 to 4c per gal., were Los Angeles valley, Chicago, Milwaukee and Tampa.

Natural gasoline prices fell five times during the month, for a total decline of 1.875c, Group 3, and 1.625c, Breckenridge, Texas. Sales at the new lows of 4c, Group 3, and 3.75c, Breckenridge, were reported.

Light fuel oils at East Coast terminals were subject to suppliers' discounts varying from 0.1 to 0.55c per gal. from their posted terminal prices. On the other hand, refiners in Oklahoma and Kansas said they had little or no light fuel oil to offer after meeting their commitments to regular customers.

Crux of the matter was gasoline. Demand was anticipated to be heavy this Spring, but already there was a considerable supply available. So long as the imports question raged, while dollar and sterling sellers abroad couldn't get together, the domestic refiner chose to adopt a cautious outlook toward his own operation.

Apparently the industry was correcting a supply problem without the painful adjustments of a general change in the price structure.

• • •

DEMAND

More product storage capacity is required by the industry, according to Jerry A. Cogan, of Jersey Standard's coordination and economics department, to offset the increasing apparent effect on refinery operations of such variables as the weather, business conditions, and the like.

Speaking to the petroleum branch of the American Institute of Mining and Metallurgical Engineers he suggested that "probably the best and normally the cheapest method for a company to provide flexibility and at the same time minimize the ups and downs in petroleum supply operations is through a carefully thought-out inventory program. Such a method obviously requires adequate tankage (rather more, in my opinion, than that owned by the individual companies of the industry)." See more complete story, this issue, pg. 241.

• • •

SYNTHETICS

Shale oil currently represents most promising source of liquid fuels for Pacific Coast when existing petroleum reserves are exhausted, according to S. H. McAllister, associate director of Shell Development Co.'s Emeryville, Calif., research laboratories.

Ample petroleum is still available, McAllister emphasized in a talk to the California Section of the American Chemical Society, and there is now no need to build commercial shale oil plants "unless it could be justified on strategic grounds." He urged, however, that development work be continued so that the best methods of obtaining and refining shale oil can be determined in time to be pressed into use when necessary.

• • •

TRANSITION

McCarthy Chemical Co. has shut down it chemical unit at Winnie, Texas, making methanol, acetaldehyde and formaldehyde, because of high production costs and also to check, revamp and repair equipment. The absorption plant unit continues operation, producing natural gasoline and condensate.

Sunray Oil Co. has paid Atlas Corp. and Ogden Corp. approximately $44.8 million for some 800,000 shares of Barnsdall Oil Co. common stock in a deal to merge Barnsdall with Sunray by a plan to be taken up with affected stockholders in near future. Combined companies will have about 60,000 b/d of crude production (22 million bbls. annually) and total assets of more than $250 million.

Quaker State Oil Co. on Feb. 11 shut down its Oil City, Pa., plant for an indefinite period for repairs. Plant has skimming and conventional lube units, with capacity of about 2500 b/d.

Sherwood Refining Co. has bought the cottonseed oil plant of Seaboard Refining Co. at Gretna, La., and plans to convert it at a cost of $500,000 to make petrolatum, white mineral oil and petroleum sulfonates. Plant will have a capacity of 1000-2000 b/d. Sherwood already operates three specialty plants in the east.

• • •

MISCELLANY

For Sale: 35,000-45,000 b/d two-stage vacuum and atmospheric pipe still. Standard-Vacuum Oil Co. originally ordered the unit back in 1944, when the company thought it would need the equipment to restore its refinery at Palembang, South Sumatra. The old units were repaired, however, so the new one is still in this country—and available.

Foster Wheeler Corp., process and construction engineering firm, has opened an office in Paris, and soon will organize a French subsidiary, Societe Foster Wheeler Francaise. Roger Serre, formerly of the company's New York export sales office, is sales supervisor in the Paris office, 6, Rond Point des Champs Elysees.

Have You a Gasoline Additive Problem?

Let a Du Pont Field Laboratory Help You

Wherever your refinery is located, there is a Du Pont Field Laboratory within easy calling distance. It is staffed and equipped to determine the additive needs of your fuels—and to recommend the most effective and economical methods of meeting them.

Each Laboratory is prepared to work with you in the use of Du Pont's complete line of gasoline additives—Tetraethyl Lead Compounds, Antioxidants, Metal Deactivator and Dyes. This service includes:

- Induction period evaluations and gum tests to determine antioxidant and Metal Deactivator response.
- Antiknock ratings to check TEL susceptibility of blending stocks and octane number of finished gasolines.
- Color determinations for dye studies.
- The many standard gasoline inspection tests.
- Other assistance in the use of additives.

These Laboratories are ready not only to assist in the use of Du Pont Additives, but to check your own laboratory findings as well.

So, when you have a gasoline additive problem, let the nearest Field Laboratory make the necessary recommendations from Du Pont's complete line of gasoline additives. Just call your Petroleum Chemicals representative or write the nearest District Office listed below.

Each Field Laboratory is equipped to render complete service on gasoline testing and the use of additives.

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Special technique assures quality of Kellogg "knock-down" vessels

ONE of the frequent causes of high cost in the field-construction of large refinery vessels does not really start in the field at all. Actually it occurs in the shop-fabrication of these "knocked-down" vessels.

Mis-alignment is the field man's bogey . . . mis-alignment, not only between segments of any one course of a vessel but also between the different courses themselves.

To preclude the possibility of saddling any constructor's field crews with the costly field correction of "misfits," Kellogg shops follow a special routine developed from both *shop and field* experience.

In effect Kellogg completely "builds" even the largest vessels right in the shop. Beyond matching individual segments to master templates, each successive course of every vessel is superimposed on the previously assembled course. "Knocked-down" vessels built in this manner for the field can't help but fit.

Such accuracy in fabrication has brought wide recognition of Kellogg quality in all types of vessels. It gives assurance of exact tray positioning and leveling and of close tolerances in nozzle positioning. It's another reason why Kellogg vessels—completely shop-built or shop built in "Knock-down" form—achieve high operating efficiencies and low maintenance records.

Illustrated—Alloy clad 23' diameter reactor being "Knock-down" fabricated in Kellogg shops.

To master temperature and pressure use

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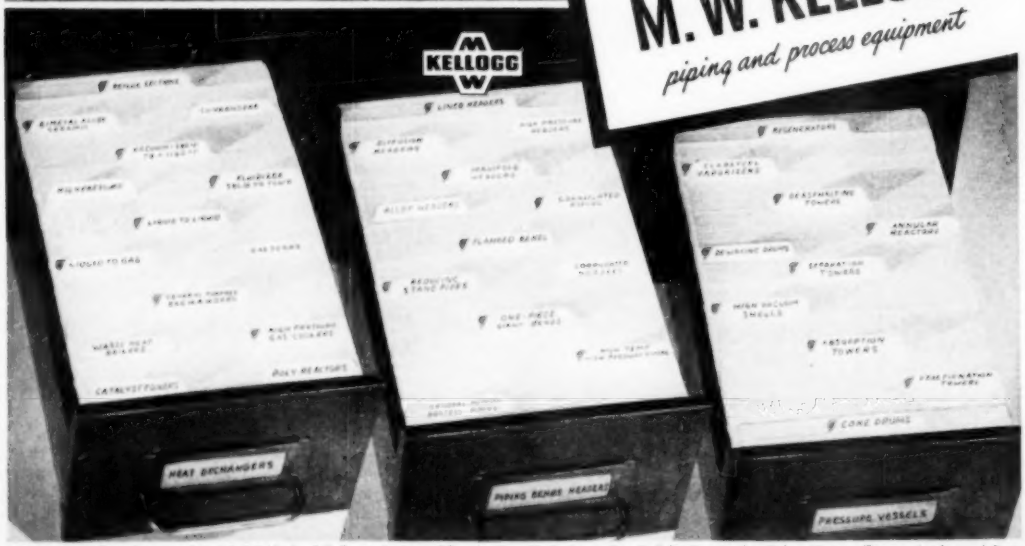
piping and process equipment



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Tomorrow
. . . IN PETROLEUM TECHNOLOGY

By B. H. WEIL, Atlanta, Ga.
Editor, "Monthly Summary of Industrial Developments"

Brief Reviews of Current Technological and Economic Developments, Reported in the Light of Their Possible Effect on Future Petroleum Processing Operations

Synthetic Detergents Gain Despite Soap's Competition

SYNTHETIC detergents have entered the kitchens of the nation. On grocers' shelves, they compete side by side with soap products for the housewife's dollar. Year by year, they are taking an increasing portion of that dollar. All this is of considerable interest to the petroleum industry, for it means another of its products is gaining wide consumer acceptance.

According to a recent estimate by Foster Dee Snell,[1] production of built synthetic detergents totaled 300,000,000 lbs. in 1947, 500,000,000 lbs. in 1948, and 800,000,000 lbs. in 1949. "The most important products, volume-wise, are derived from petroleum and are alkyl aryl sulfonates, with some alkyl sulfonates. Those from fat sources are mainly alkyl sulfates, sulfonated acid amides, and sulfated monoglycerides. The petroleum-derived type stepped still further into the lead in 1949. Paralleling that, England multiplied her production of alkyl aryl sulfonates and at the same time increased the secondary alcohol sulfates derived from paraffin—the Teepols. This represented an economy in fat stocks and was derived in large part from hydrocarbons furnished by U. S. companies or their affiliates. The same thing to a greater or lesser degree is true of all accessible European countries.

"The trend in recent years, here and abroad, has been to a division of labor. The petroleum bases for sulfonation are mainly produced by petroleum chemical companies. Their sale in bulk permits the modest-scale, local production of the end product by companies with a background of sulfonating experience. The main drawback is the cost of equipment for drying. A low five-figure investment in drying rolls, or in a small spray tower, is required.

"Recent declines in production cost of synthetic detergents have not followed those for soap. Basically, the raw materials are much less expensive, but their fabrication into the desired molecular structures requires elaborate plants. Thus, raw materials averaging well under 3c per lb. yield delivered alkylate at around 15c per lb. Because of increased wartime capacity for making toluene from petroleum, that type of alkylate is lower in price than that from benzene. One pound of alkylate in turn yields something over 3 lbs. of built synthetic. So the present status is that built synthetic competes on an approximate price equality with built soap products, but the degree of building effective with the synthetic is much greater than that commercially practiced with soaps.

"On the basis of anhydrous active agent, even the lower-price alkyl aryl sulfonates cost at least 2.5 times the soap price. The alkyl sulfates, which cost even more, are built further; this compensates for the high production cost." Many new uses for synthetic detergents and similar surface active agents are being developed, and Snell expects continued increases in their use, despite recent lower prices for soap which permitted "an over-all 10% increase in 1949 soap production over that of 1948."

It has been reported elsewhere[2] that Proctor & Gamble is leading the field in the marketing of synthetic detergents. "Authoritative independent surveys measuring market trends for manufacturers indicate that the various heavy-duty detergents now account for a quarter of all the soap sales, and 'Tide' (a P & G product) laps up 75% of that big fraction." Colgate's "Fab" is a poor second in this field, and Lever Brothers' "Surf" is rated a distant third. "An additional 10% of today's soap market has been gained by the 'light duty' synthetic detergents, excellent for the dishpan and for rinsing out hosiery. . . . In this race there has been a neck-and-neck sprint between Colgate's 'Vel' and P & G's 'Dreft.' . . . Lever's 'Breeze' is 'far down the line.'"

A near-future market of a billion pounds per year is big business in the petroleum chemicals field. It is to be expected that increased attention will be paid to lowering costs and increasing the quality of products; if major gains can be effected in these directions, soap production may go the way of the horse and buggy or—as now seems imminent—the way of the steam locomotive.

New Petroleum Chemical Enterprises Announced

IN these days of increased conservatism as regards new plants and projects, it is still significant to note that the petroleum chemicals field has not yet reached a "dead-center" state of equilibrium, that new products continue to appear and new plants continue to be built, both by established firms and newcomers to this field.

The $15,000,000 project of the Pontiac Refining Corp. and the Chicago Corp., announced in January, is typical, albeit somewhat larger than usual, of developments in this field. While these companies will not "start from scratch," since their plant will be based on units in the 100-octane gasoline refinery at Corpus Christi, Texas, which was formerly operated for the Government by the Great Southern Corp., it is evident that a broad program of petrochemicals manufacture has been envisioned.

Initial units will produce 60,000,000 lbs. per year of ethylene glycol, 10,000,000 lbs. of ethylene oxide, and 5000 b/d of "high-grade" gasoline. Other products for which preliminary plans have been made include butadiene, ammonia, ammonium sulfate, ethylene dichloride, butyl alcohol, polyethylene, and a "super-octane" blending agent whose identity was not disclosed.

Operations will be based on natural gas and extractable LPG and natural gasoline, since the original aviation gasoline plant did not employ petroleum as such in its operations. According to a statement from the two companies involved in the project, "a 20-year supply of light petroleum hydrocarbons, which will be the basic raw materials for the chemical development, is contained in the natural gas reserves of the Chicago Corp., and additional reserves are still being developed in this area."

It is interesting to note, incidentally, that an option on the original 100-octane aviation gasoline plant was held for some time by the Pittsburgh Consolidation Coal Co., which was considering converting it to the production of gasoline and other products by the Synthine process. This plan was apparently abandoned at the same time that this company closed its Library, Pa. pilot plant for gasoline synthesis from coal.

The Southwest is not the only region where new petrochemical enterprises are being planned. While no definite program has been announced, it is rumored that "almost every ma-

jor oil company on the West Coast is keeping a sharp eye on possibilities for an ethylene-based chemical industry in the west."[9] Ethylene glycol, here also, would probably be the initial product, although the threat of an over-supply of this material in the east might be a deterrent.

In any case, it is quite evident that the petroleum chemicals industry is not a dormant one. Moreover, should the price of petroleum and its products decrease, because of "a flood of foreign oil," it is not at all unlikely that the tempo of developments in this field will be increased.

Imports Could Influence Synthetic Fuels Future

ONE factor which is being somewhat ignored in the current furore over increased petroleum imports is the effect these imports may have on the future of the synthetic fuels industry. According to Bureau of Mines' statements, the production of gasoline from shale oil and even from coal is no longer much more expensive than from crude oil *at present price levels for the latter substance*, and even the petroleum industry agrees that estimates for the production of synthetic petroleum from natural gas via the Synthine process indicate the possibility of direct competition in the immediate future, despite high equipment costs.

All such competition, however, is predicated upon one factor: maintaining the cost of crude oil at present levels or above, since it may be assumed that the unit costs of labor and construction will not decline materially in the near future. As regards the present price of oil, all within the petroleum industry (save those independent refiners who claim their operations have been rendered unprofitable by it) are agreed that its maintenance is of the utmost importance to a healthy production industry in which exploration for additional oil must be encouraged.

Events of the past few months, however, have indicated that there is a definite possibility that crude oil prices may decline in the wake of an increased flood of imports of oil from the Middle East and Venezuela, oil which, barred from the "sterling areas" by British decree, can be marketed in this country at prices well below those now prevailing.

To keep domestic oil production on an even keel, producing states, during 1949, materially cut their output in the face of lower-than-expected consumption and increasing imports, but it now seems likely that further production cuts will not solve the problem.

As economists within the petroleum industry know full well, there is no simple answer. A low-limit ban on imports might serve for the minute, but setting of the exact limit would have to be highly flexible to meet possible emergencies—and placing of this power in Governmental hands, as would certainly have to be done, would be an opening wedge into Government control of the industry. High import tariffs might also slow the flood, but here again they would have to be flexible unless it is intended that they should completely still the tide—which is not practical in the light of this nation's need for some imports to balance its refining picture. Moreover, much of this "foreign" oil is produced from properties owned by American companies, properties which may be lost if no markets for the oil are available; foreign governments are all-too-dependent upon revenues from such oil production.

Events in the next few months may very well determine the future of the synthetic fuels industry during the next decade. If crude oil prices do decline, and if it appears that they will not come back to present levels in the predictable future, it can certainly be expected that the petrolum industry will be forced to shelve much of its research and planning in this field. Then certain Government agencies will then come out full-force for a Government-owned synthetic fuels industry as a measure for national security.

On the other hand, if crude oil prices continue stable and some suitable solution is found to the import problem, then it appears equally as probable that improvements in processes and reductions in their operating costs will gradually bring a number of petroleum companies into the petroleum synthesis field.

The whole situation warrants careful, sober analysis. Hasty decisions in high places can have far-reaching effects.

Congress Will Determine Synthetic Rubber Program

PRESIDENT Truman's recent report to Congress[10] on the disposal of synthetic rubber plants recommends gradual elimination of Government supports and controls and the disposal of these plants to private industry by methods which, however, would impose definite restrictions. It is desired that the total plant capacity, in operation and on stand-by, should approximate present levels, and that sales contracts for plants disposed of should include the stipulation that these plants be kept in a condition that will permit resumption of the production of synthetic rubber. While Truman recommends that only technically and financially qualified concerns be permitted to buy the plants, he also stipulates that great precautions be taken to prevent concentration of ownership in the hands of the large rubber companies.

In order that prospective buyers may know where they stand, Truman recommends that legislation drafted by Congress should provide for a ten-year period. The Government, he feels, should retain authority to establish minimum levels of production and consumption of synthetic rubber and the proportion of synthetic to be used in rubber products. Continued Government research in the synthetic rubber field was recommended, until such time as all plants are in the hands of private industry.

"No sale of both a butadiene and copolymer facility to a single concern should be permitted where such concern already controls one or both of the remaining two steps, in terms of vertical integration, in the ultimate production of rubber products from raw materials, except upon a special finding by the President that such disposal would be consistent with the development of effective competition."

As regards Butyl rubber plants, the President recommends that no more than one plant should be sold to a firm dominant in its industry unless "It is found that other disposal is impractical and that disposal to a dominant firm is in the public interest." It was recommended that the Torrance, Calif., butadiene plant "be turned over, if wanted, to the Air Force for use as a ram-jet testing facility, subject to requirements that the plant be maintained in adequate stand-by condition as long as necessary." President Truman's budget for the fiscal year 1951 included expenditures for RFC operation of the plants at approximately present levels. Production of general-purpose synthetic rubber was scheduled at 284,500 tons, compared to 305,000 tons for the present year; special-purpose synthetic rubber production was set at 51,000 tons compared to 56,200 tons in the fiscal year 1950.

Synthetic rubbers are products of the refining industry, at least as regards raw materials. The legislation which Congress enacts on this subject in coming months will have a great bearing on the future development of this auxiliary of petroleum refining.

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(2) Anon., "'Soap Titles' Strife: Lever Loses Markets to P. & G. Cogate in Hot Battle," *The Wall Street Journal* 135, No. 26, (1950).

(3) Anon., "Newsletter," *Chemical Industries* 66, No. 1, 15 (1950).

(4) *Synthetic Rubber. Recommendations of the President, Transmitted to the Congress Together With a Report on Maintenance of the Synthetic Rubber Industry of the United States and Disposal of Government-Owned Synthetic Rubber Facilities from the Assistant to the President* (John R. Steelman), Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., January, 1950. 124 pages. 40 cents.

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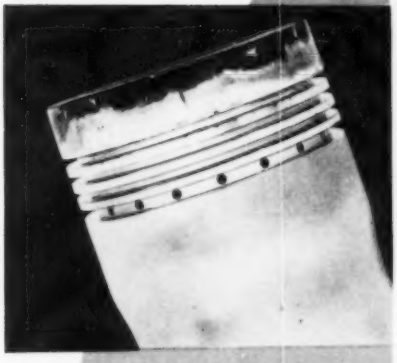

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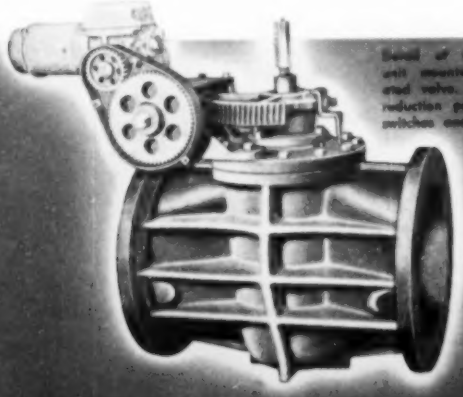
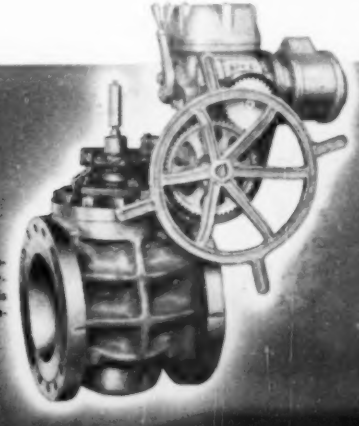


Detail of Cutler-Hammer electric motor unit mounted on Nordstrom gear-operated valve. Assembly consists of motor, reduction gears, declutching device, limit switches and contacts for controlling position indicating lights.



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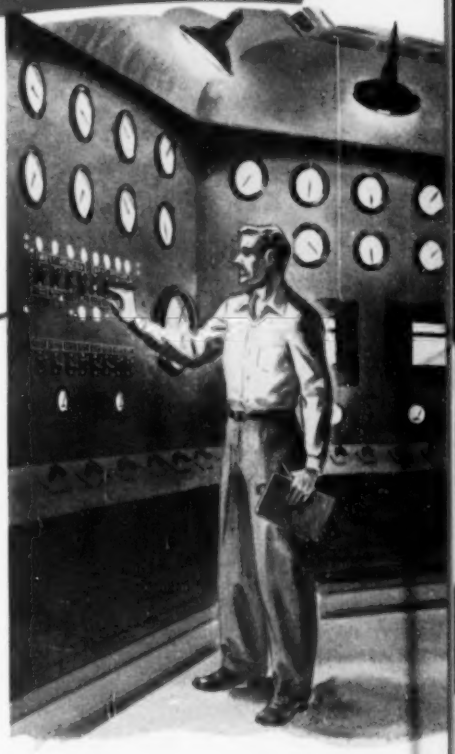

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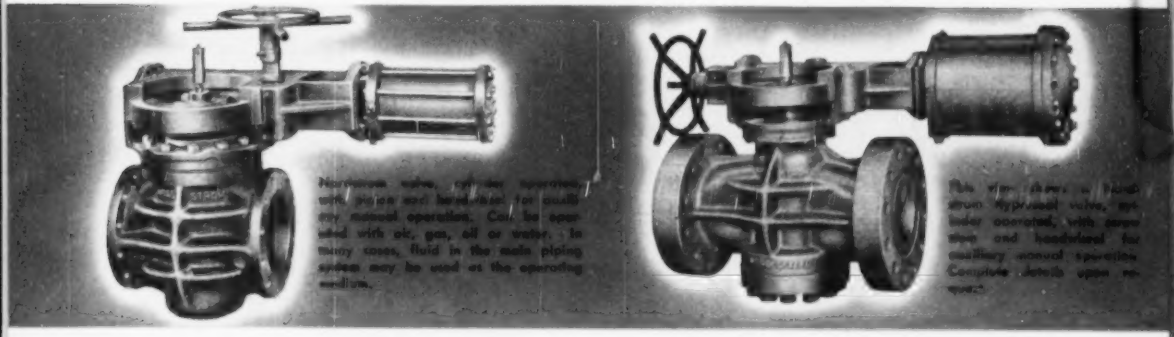

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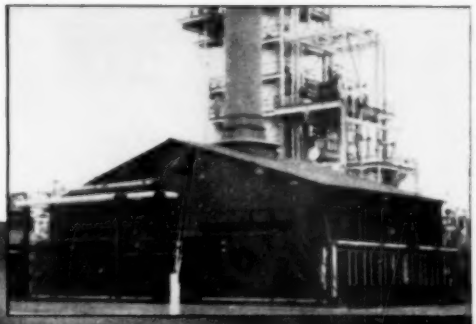

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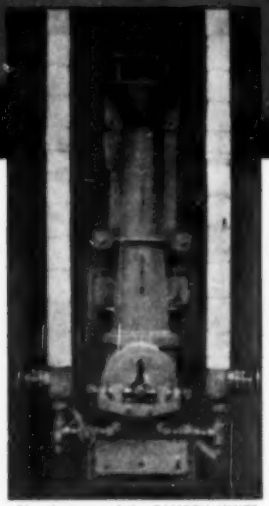

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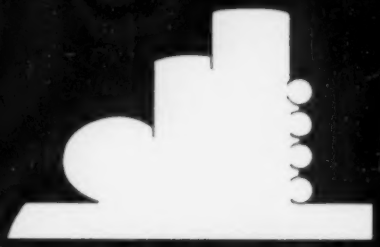

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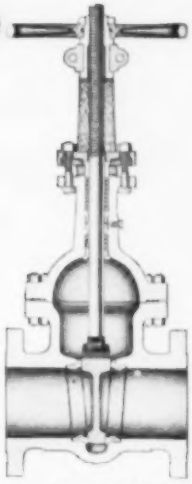

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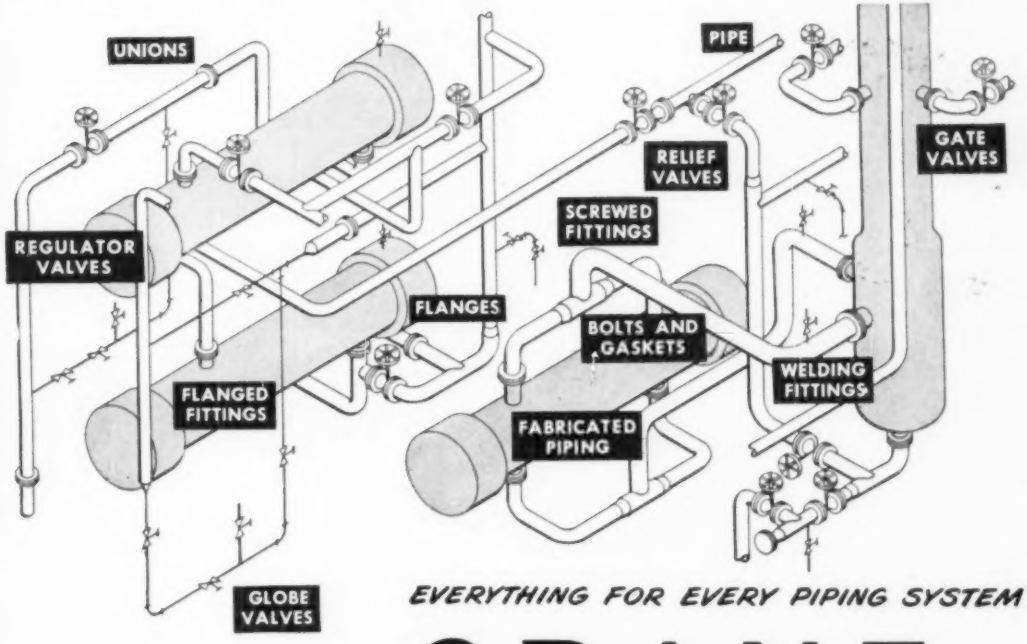

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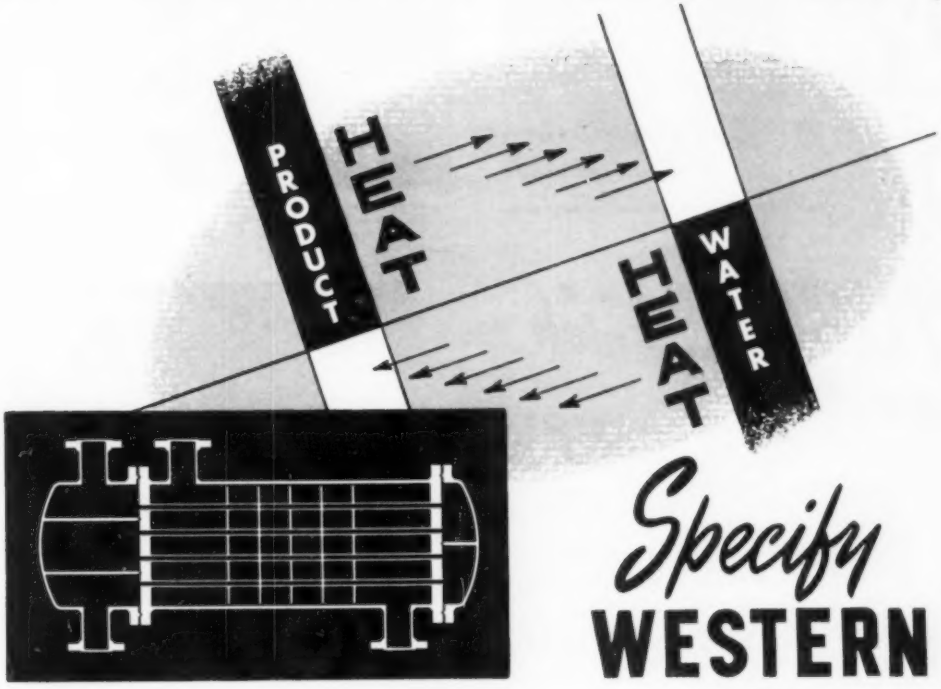

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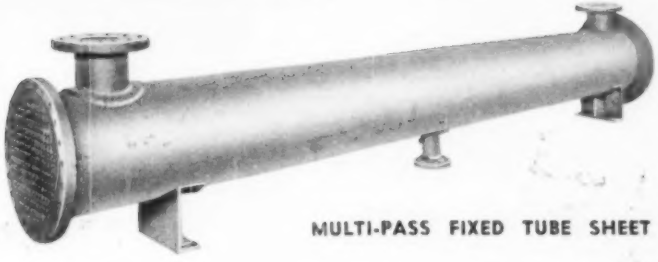

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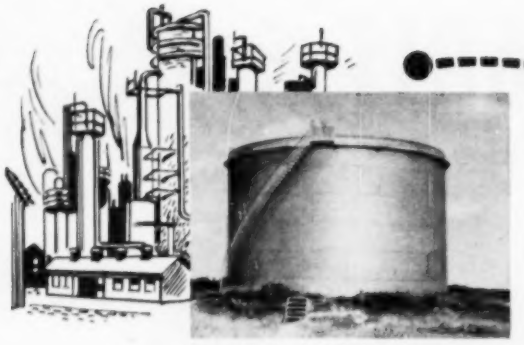
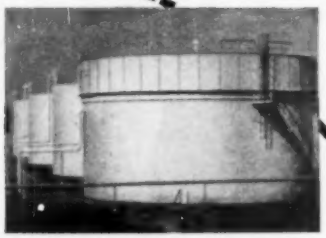


Graver Floating Roof Tank . . . for sour crude oil storage . . . for finished petroleum products storage. Capacities from 5,000 barrels *up*.

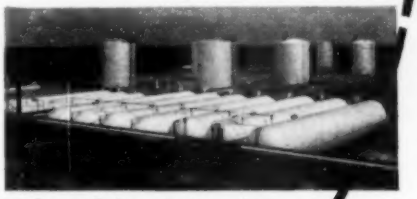


Graver Expansion Roof Tank . . . for vapor-saving storage of volatile products in single or multiple installations. Prevents breathing and filling losses. Capacities from 5,000 barrels *up*.

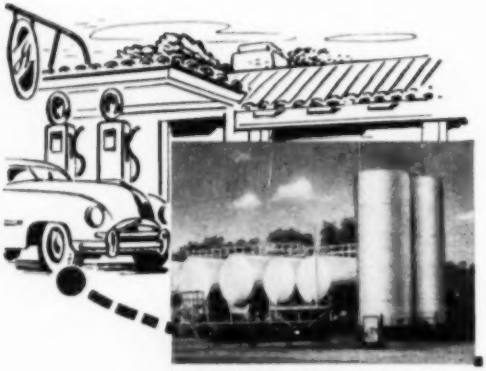
STORAGE . . . from start to finish by GRAVER

From oil field and refinery to bulk plant and service station . . . producers, refiners, and marketers are choosing Graver tanks for safe, economical storage of petroleum products. Make sure *you* have full facts and figures on the *complete* Graver line. Write for latest data.

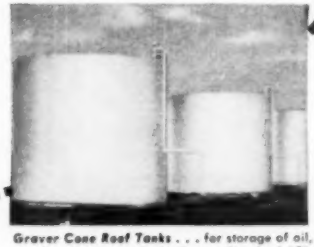
Gravercpheres . . . for storage of volatile liquids—butane, butadiene, etc.—and natural gasolines . . . for storage of gases. Pressures from 20 to 100 lbs. psi, or more. Capacities from 500 bbls. to 20,000 bbls.



Graver Pressure Tanks . . . for storage of propane, butane, etc. for all necessary pressures. Made in bullets (as shown) and spheroidal or cylindrical tanks. *Any* capacity.



Graver Bulk Storage Tanks . . . for storage of all finished petroleum products. Horizontal, vertical, or underground installation. Shop built. Capacities from 550 to 40,000 gallons.



Graver Cone Roof Tanks . . . for storage of oil, gasoline, kerosene, fuel oil, etc. Standard-API. All-welded construction. Field erected. Capacities from 50,000 gallons *up*.

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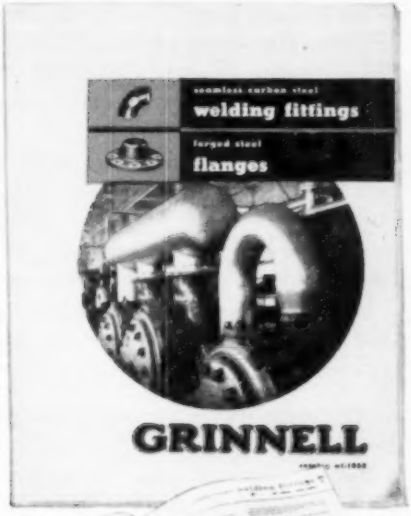

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- 90° elbows . . . long radius, short radius, light gauge, special wall thicknesses
- 45° elbows . . . long radius, light gauge, special wall thicknesses
- 180° returns . . . long radius, extra long radius, short radius, light gauge, special wall thicknesses
- tees . . . straight, reducing
- crosses
- reducers
- laterals
- lap joint stub ends
- caps
- saddles
- backing rings
- dimensional tolerances

FORGED STEEL FLANGES

- welding neck . . . 150 to 2500 lbs.
- slip-on . . . 150 to 2500 lbs.
- lap-joint . . . 150 to 2500 lbs.
- threaded . . . 150 to 2500 lbs.
- blind . . . 150 to 2500 lbs.
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- reducing . . . threaded and slip-on: 150 to 2500 lbs.
- orifice . . . slip-on; welding neck; welding neck, ring joint; threaded: 300 to 1500 lbs.
- flange extras
- dimensional tolerances
- minimum finished bores
- flange facings
- facing dimensions of ring joint flanges
- thread standards and threading practice
- service pressure ratings
- physical and chemical requirements

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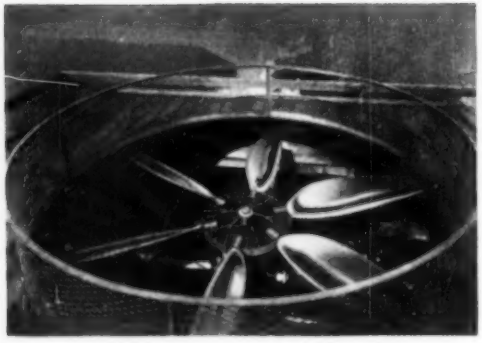
Why are Oil Refiners standardizing On Hartzite Cooling Tower Fans?



This is significant: Since 1941, thousands of Hartzite plastic fans of 10′ to 22′ diameter have been installed in oil refineries, and *not one* has failed for any cause except obvious abuse.

No wonder oil refiners are standardizing on the Hartzell cooling tower fan!

The Hartzite blade is not only extremely resistant to vibration and shock damage, but also practically impervious to weathering and the acids and alkalies found in oil refining. It stands up unusually well against abrasion.

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This fan solves one of the most irritating and costly problems of the industry. We invite *you* to clip and mail the coupon below for full information, or drop us a line. And remember — new tower or replacement, *insist on Hartzell* fans, 3′ to 22′ diameter.

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. . . and Foxboro offers the *right* meter for every refinery measurement. See the typical applications below.

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	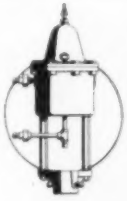	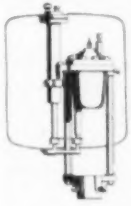	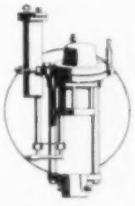	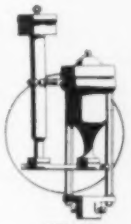
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Specifications of Foxboro Meter Types Illustrated

TYPE	MATERIAL	MAX. W. P.	RANGES
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9	Cast Iron	150	2½"–10"
17	Forged Steel	1800	10"–400"
8	Forged Steel	1500	50"–400"
6	Forged Steel	3500	100"–200"

FOXBORO REG. U. S. PAT. OFF. **FLOW METERS**

POWELL VALVES have *these* "ABILITIES" to a high degree:

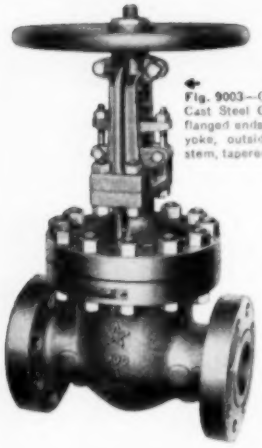

Fig. 9003—Class 900-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem, tapered solid wedge.

ADAPTABILITY. The Powell Line is so complete* that there's a Powell Valve especially adapted, in design and material, to meet the requirements of each and every industrial flow control service.

DURABILITY. Powell Valves are noted for their durability. That is because each Powell Valve is built to stand up under the specific flow control conditions to which it may be subjected.

DEPENDABILITY. Every Powell Valve is specifically designed to give dependable, uninterrupted service over a long period of time. That is why Powell Valves reduce costly "down time" for maintenance to a minimum.

Fig. 1793 — Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge.

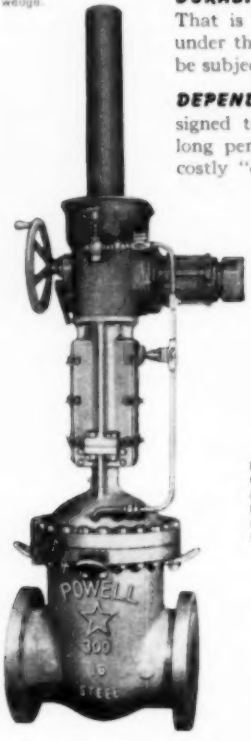

Fig. 3023—Class 300-pound Cast Alloy Steel Gate Valve with automatic steam sealing mechanism. Has explosion proof electric motor operator.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

Fig. 3061—Class 300-pound Cast Steel Swing Check Valve with flanged ends and bolted cap. Disc has ample lift to permit full, straightway, unobstructed flow through the valve body.

*The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.

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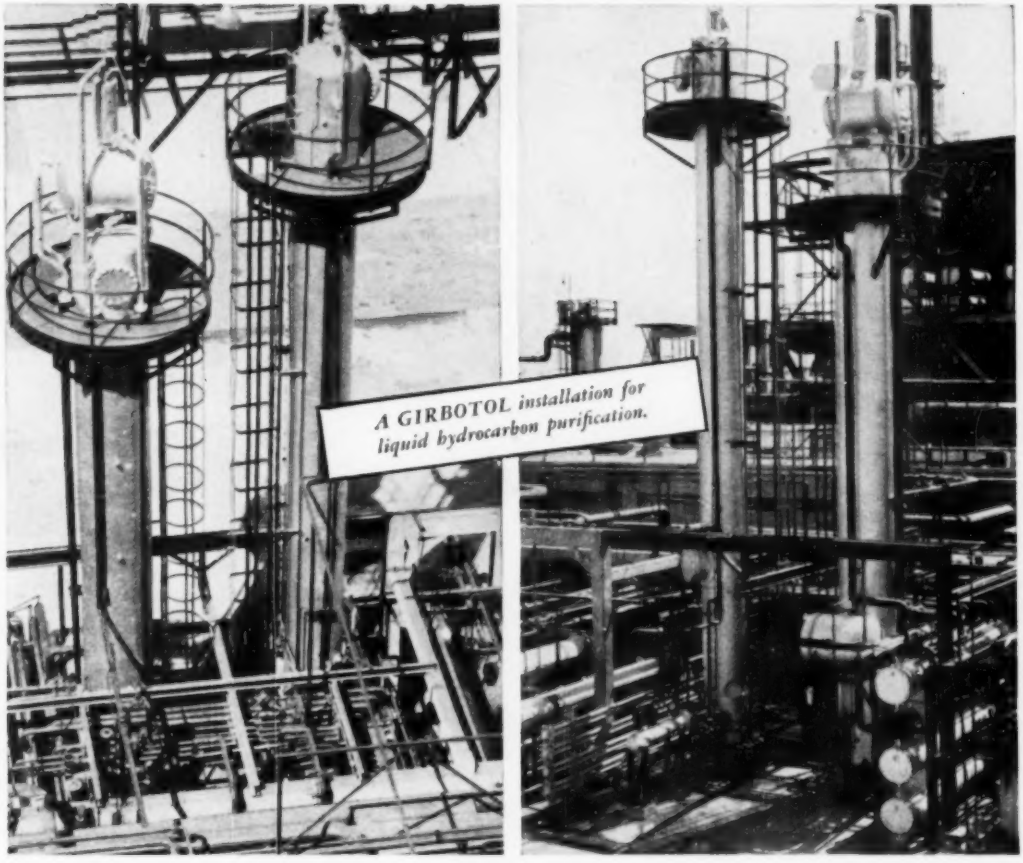

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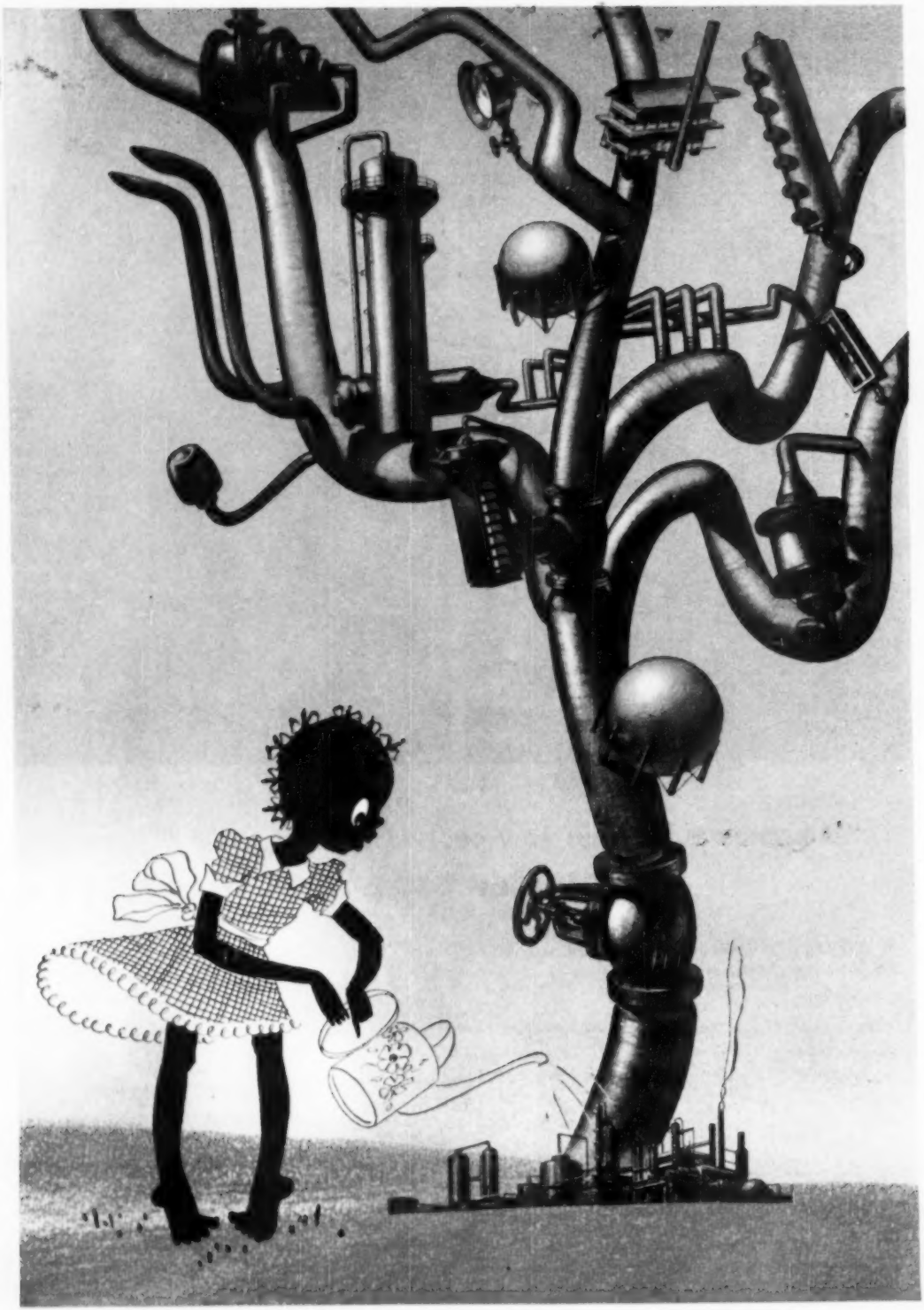

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A Badger plant is not like Topsy — it doesn't just grow. A Badger built plant is thoroughly planned and planned with imagination and experience.

This planning is apparent in orderly layout of all component parts for easy operation and efficient control. It is apparent in the location of equipment for ready access when maintenance or replacement is required.

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When your plant is designed and constructed by Badger, the value of this planning is quickly demonstrated by operational economy and production quality.

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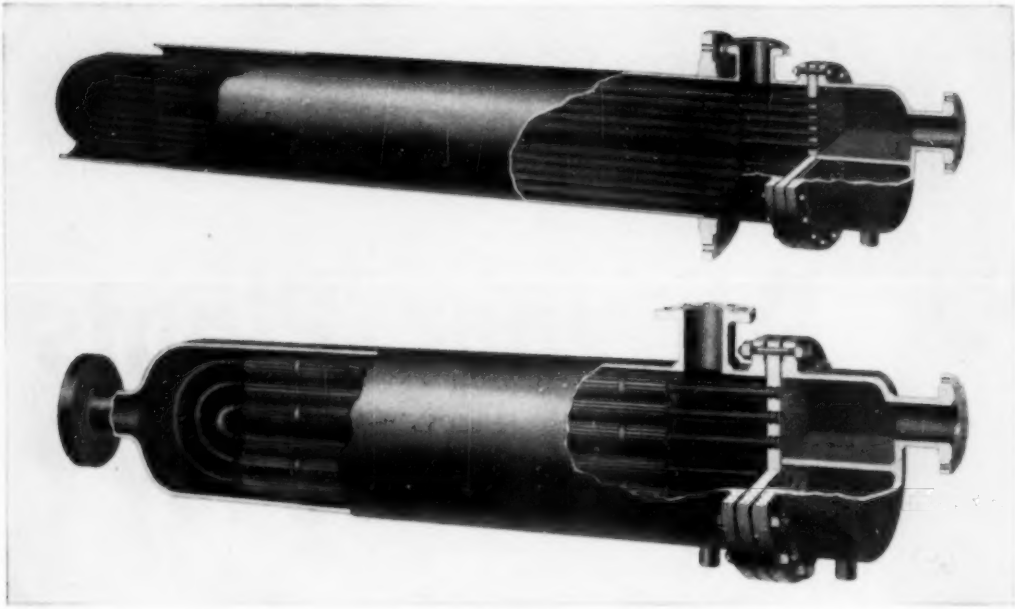
Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries



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● Brown Fintube Tank Suction Heaters are moderately priced and highly efficient. They heat viscous oils so that they can be pumped more easily, and bolt or weld to a tank nozzle, or directly to the tank shell, so all piping and connections are made outside the tank.

The Line Heaters are used as Suction Heaters to permit easier pumping of viscous oils; — or as Pressure Heaters, either to overcome temperature losses in long lines, or to preheat liquids for further processing.

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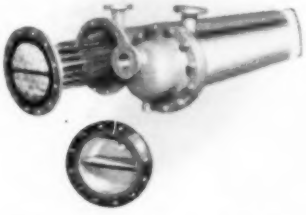

Hairpin Bundle Assembled in Shell Showing Mounting of Tube Sheet Between the Shell and Head.

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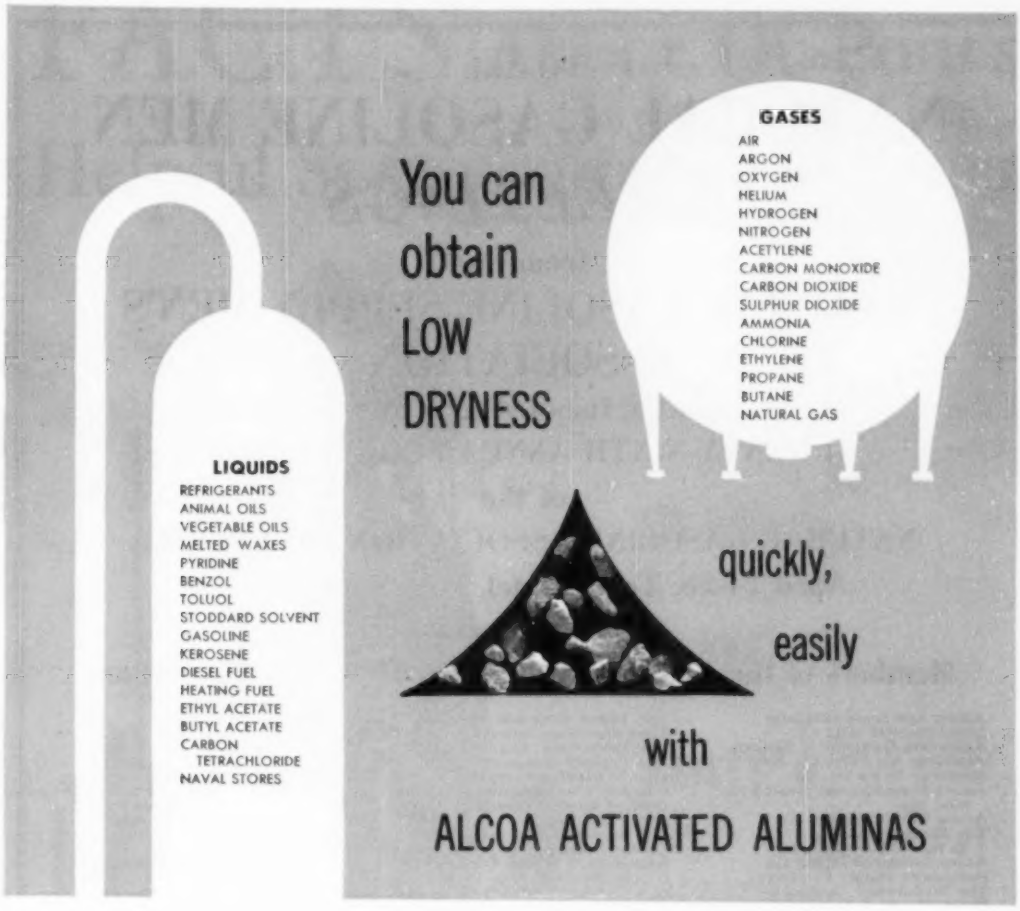

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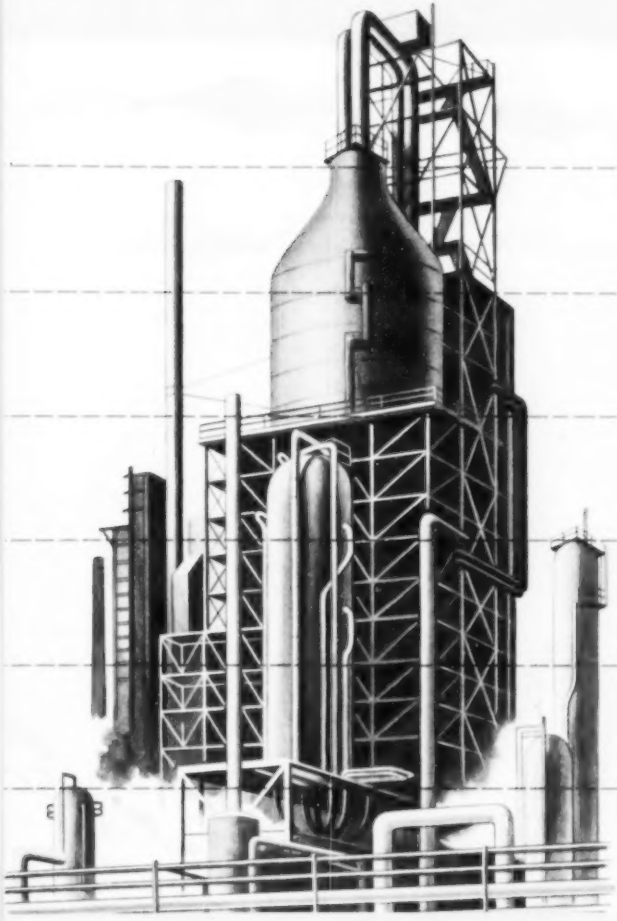
FACTS About Du Pont's Helpful Services to the Refiner



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DU PONT

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How Du Pont TEL Services can help you

What petroleum chemicals research facilities does Du Pont have?

Du Pont maintains a complete research department devoted to the study of fuels and their components, both from a chemical and an engineering standpoint. Center of the Petroleum Chemicals research effort is at Deepwater, New Jersey. Road test fleets operate out of this headquarters as well as out of the El Monte, California Road Testing Laboratory.

What other research facilities does Du Pont have?

In addition to the research carried out in the Petroleum Chemicals laboratories, specific projects are maintained in the company's experimental station for which a new $30,000,000 building project is nearing completion in Wilmington. The findings of other laboratories throughout the company are available at all times for consideration as to their application to the petroleum industry.

What are the objectives of Du Pont Petroleum Chemicals research?

Du Pont has initiated a long-range program of fundamental research leading to a better understanding of the combustion process and its chemical control. A wide variety of studies are under way to help refiners utilize present TEL compounds most efficiently. Others are aimed at improving antiknock compounds. Research is also conducted on other gasoline additives.

What Technical Service does Du Pont offer?

Du Pont provides an integrated technical service that works with refiners, equipment manufacturers and fuel users.

Does their work treat with refinery operation?

Du Pont's men are fully trained in the various phases of refinery work and are able to consult with your management, research and development groups, not only upon problems related to the most efficient utilization of TEL Compounds, but also upon refining and treating processes that relate to the use of additives.

Is Du Pont prepared to offer further technical services?

Du Pont Technical Representatives will keep you advised on the latest technological developments in the refining and additives field and will work with you toward their incorporation into your own processes. They will also assist in training personnel in precision test methods.

Does Du Pont consult with automotive manufacturers?

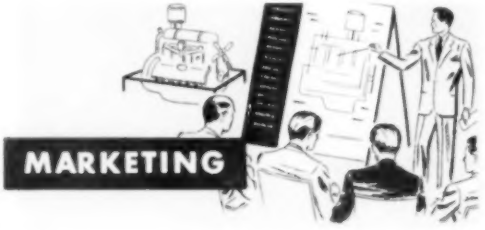
Yes. Du Pont has a staff of experienced engineers whose function it is to consult with research and technical groups of automotive manufacturing companies on problems related to the utilization of leaded fuels and other problems concerned with design and engine performance.

Does Du Pont also consult with tractor, truck, bus, aircraft engine and other manufacturers?

Du Pont works with all types of engine manufacturers on problems to improve engine-fuel relationships and on problems associated with the utilization of leaded fuels.

What other aids does Du Pont offer?

The results of Du Pont research are made available through the publication of papers and through joint meetings of Du Pont and refinery research personnel. By widespread dissemination of such information, Du Pont contributes toward the creation of better fuels and their more effective use.



What facilities does Du Pont offer to aid the refiner in his marketing program?

Representatives working out of the Du Pont District Offices are ready at all times to assist your marketing groups on specific promotional programs.

Can these men be called on to conduct meetings and help in educational work?

Yes. These representatives are available to work with

your own marketing group in conducting educational meetings among dealers and other personnel.

Does Du Pont supply information that will help a refiner evaluate the position of his fuels?

Du Pont provides a comprehensive quarterly gasoline survey which shows the octane rating and TEL content of individual gasolines in all geographical sections of the country.

Is Du Pont prepared to render assistance on automotive operational problems?

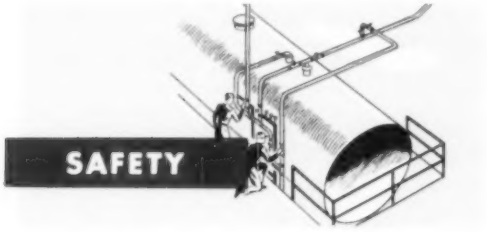
Du Pont's field engineers are always available to work with refiners and assist in applying preventive maintenance for truck, bus, tractor, and other automotive equipment operators.

How about aircraft engine operation?

These helpful field services are also available to work with airlines and airports on specific engine operating problems.

What about deliveries?

As the operator of its own fleet of tetraethyl lead tank cars, Du Pont has been able to maintain scheduled deliveries throughout the country.



Does Du Pont maintain a safety service for the benefit of those using Du Pont TEL Compounds?

Yes. It is made up of a group of specially trained men who can help you in many ways to insure the safe handling of tetraethyl lead compounds.

Can Du Pont help in making blending plant layouts?

Yes. Standard or special plans and specifications, as well as actual on-the-spot assistance, are provided in blending plant construction.

Does Du Pont help to train personnel for operation of the blending plant?

Yes. Du Pont will supply the type of training that results in safe employees and an efficient operation.

What does Du Pont provide in the way of inspection and maintenance supervision?

The safety services provide users of Du Pont TEL Compounds with a regular quarterly inspection service, assist in the application of preventive maintenance, and supervise any necessary maintenance and repair work. They will also advise on problems related to the cleaning and repair of tanks which have contained leaded fuels and will attend and advise on tank entries.

What about emergency field help?

On any problem involved in meeting emergency field conditions, Du Pont safety men will assist in working out a satisfactory solution.

What other services are offered by the Safety Group?

They will keep your personnel abreast of the latest approved methods of handling, circulating, and mixing TEL Compounds. They will work with your own laboratory personnel on problems related to the handling of TEL. In addition, they will help you in determining the adequacy and safety of your blending plant equipment and methods.

Does Du Pont supply a medical service in connection with the use of Du Pont TEL Compounds?

Yes. The Du Pont medical service comprises a group of physicians specially trained in industrial hygiene and particularly in the health problems that relate to the handling of tetraethyl lead compounds. They are always ready to cooperate with you in safeguarding the health of employees working with TEL Compounds.

Does the Medical Service aid in the selection of employees to work with TEL?

Yes. They will make preliminary health studies to determine employee suitability for work in these locations.

Does their responsibility end with the selection of the employee?

No. They will also make periodic examinations of such personnel to insure that proper hygienic standards are being maintained.

What other medical service is available?

In addition to examinations of employees, the medical service is, at all times, available to consult with you on general health problems concerning the employees whose work is associated with the handling of TEL Compounds.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING

. . . Through Chemistry

FIELD LABORATORY SERVICES

These services are provided by Du Pont District Laboratories in Wilmington, Delaware; Chicago, Illinois; Tulsa, Oklahoma; Houston, Texas, and El Monte, California. Complete laboratory service is available to help you determine the qualities of your fuels, their additive requirements, and also to serve as a dependable check on your own laboratory findings. In emergencies the laboratories will furnish data that will help you to control processes. These laboratories are prepared to offer you the following services in connection with the use of any one of the Du Pont Gasoline additives.

Make DuPont the Source for All of Your Gasoline Additives

TETRAETHYL LEAD COMPOUNDS

Laboratory services are available to you for supplying octane ratings on blending stocks, determining lead susceptibility of stocks and for checking the octane ratings and TEL concentration of your finished blends.

GASOLINE ANTIOXIDANTS

Provide laboratory evaluation services in determining which one of the *three* Du Pont Gasoline Antioxidants will work best with your fuel. Work with your own personnel in determining at which point in your refining process the addition of antioxidants will be most effective.

METAL DEACTIVATOR

They can furnish you with comparative data on the economies of using Du Pont Metal Deactivator in copper contaminated stocks to lower the cost of antioxidant treatment and improve storage stability.

GASOLINE DYES

Each District Laboratory is equipped to furnish complete information on color blending with Du Pont Gasoline Dyes to achieve any desired color characteristic.

DID YOU KNOW

Du Pont Serves the Petroleum Industry With Many Products

Du Pont products used by the petroleum industry are by no means limited to gasoline additives. For example, Du Pont supplies many special explosives for seismic prospecting and for "shooting" oil wells too. Then, there is neoprene, Du Pont's durable, oil resistant chemical rubber. This finds application in many pieces of equipment. Special finishes are also supplied for tank farms, bulk plants, and other oil equipment. These are only a few of the many Du Pont products that daily find use throughout the industry.

DuPont Services Help You Use Them Most Effectively

DU PONT

Better Things for Better Living
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E. I. DU PONT DE NEMOURS & COMPANY (INC.)
PETROLEUM CHEMICALS DIVISION
Wilmington 98, Delaware

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

District Offices: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

PETROLEUM PROCESSING
MARCH, 1950

'Variables' Growing in Importance As Factors in Product Demand

From a Report by JERRY A. COGAN
Coordination and Economics Department, Standard Oil Co. (N. J.)

IT'S THE variable factors that plague refiners in their efforts to correctly estimate future demand for large volume petroleum products, Jerry A. Cogan, Coordination and Economics Department, Standard Oil Co. (N.J.), told the Petroleum Branch of the American Institute of Mining and Metallurgical Engineers, in New York, Feb. 14.

The pattern for forecasting demand based on such constants as numbers of petroleum consuming equipment and product end-use has been established and is in general use today. However, the variables, while they have always been present, have assumed increased importance in recent years because of the large volumes of motor fuels and heating and fuel oils now being handled.

The preceding two winters have demonstrated the influence of one variable factor, the weather, in heating and fuel oil demand, Mr. Cogan brought out in his paper. He listed three other variables which are important in the short-term adjustments that frequently confront the refiner and large supplier. These are: (1) the general business pattern of the country, (2) developments in the field of competitive energy sources, and (3) the human vagaries that constitute a psychological factor.

The partially unpredictable nature of the variable factors affecting demand requires the petroleum supplier of today to maintain flexibility and alertness in his operations. However, it was stated, this characteristic does not nullify the importance nor the use of supply and demand forecasts such as oil companies make up today, but it does emphasize the need to understand and use such projections properly.

"Probably the best and normally the cheapest method," said Mr. Cogan, "to provide flexibility and at the same time minimize the ups and downs in petroleum supply operations is through a carefully thought out inventory program. Such a method obviously requires adequate tankage (rather more, in my opinion, than that owned today by the individual companies of the industry). It also requires a supplier to have a carefully thought out and frequently adjusted judgment not only on the immediate situation but also on the anticipated developments over the full season.

"This sort of judgment makes it possible for a company to make a small adjustment over a considerable period of time rather than a large adjustment over a short period, and to avoid thereby some of the troubles in sharp upward and downward swings. If the individual companies do this job well, on the basis of their own independent judgments, the overall industry performance will also be good."

The four variable demand factors which are particularly important in the short-term adjustments in operations that constantly confront suppliers of petroleum products were discussed briefly in Mr. Cogan's paper.

1—THE WEATHER

Twenty-five years ago such minor influence as weather then exerted on the petroleum industry was directionally the opposite of what it is today. Summer was the period of peak demand. Over the years since the seasonality of gasoline demand diminished and there was a phenomenal growth in the use of oil for heating. Winter demand for petroleum products in this country passed that of

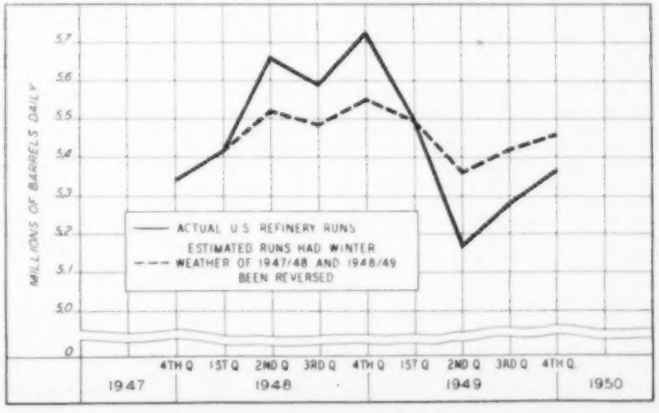


Fig. 1—Influence of weather on U. S. refinery runs

summer in the mid-thirties and today averages about 500,000 b/d, or nearly 10%, higher during a normal winter than during the preceding summer. With this disparity continuing to grow, the industry is required to recognize the increasing importance of weather on its peak demands, and adjust its planning accordingly.

To point up the importance of the weather factor, Mr. Cogan in his paper indulged in speculation of what the heating oil supply-demand situation might have been in the two preceding winters under different weather conditions. The cold winter of 1947-48 is remembered for the "shortage" scare and the warm winter of 1948-49 in areas of large oil burner concentration will go down as a period of "surplus", with huge accumulation of inventories responsible in considerable measure for the sharp cutback in operations last spring.

"These experiences were among the problems that have been the principal concern of the petroleum industry for the past couple of years", Mr. Cogan continued. "Yet, if the two winters had been reversed, it is my opinion the industry difficulties would have been reduced to a mere ripple. Fig. 1 shows in heavy lines the actual record of refinery runs by yearly quarters for the period from October, 1947, to date.

"In the dotted line is the reconstruction of a course the industry might well have followed had the winters of 1947-48 and 1948-49 been reversed and had the present winter been normal. There is room for some disagreement with the assumptions necessary to reconstruct the situation which might have existed, but such differences would not change the basic conclusion that a comparatively smooth course would have resulted not only for crude runs as shown but for crude production as well."

A common fallacy in considering the influence of weather, it was brought out, is the thought that, since part of a season has been warm or cold, the remainder of the season is likely to be the reverse, so that an average may be struck. Such statistical evidence as there is, based on so-called serial correlations of short-term relations, would tend to indicate that, on the contrary, sharp reversals during a given season are less likely than continuation of existing conditions.

Long-range weather forecasting based on the science of meteorology is still in its relatively early stages, it was brought out. Considerable impetus to this work came from the last war and research is being carried on by the Weather Bureau and other agencies. Some of the results are promising and varying degrees of success have attended the forecasts of these meteorological groups, but no completely reliable methods of the required accuracy have yet been developed.

2—GENERAL BUSINESS PATTERN

The petroleum industry is not in the front row of those most drastically affected by changes in general business conditions. However, they do have a real and important effect upon petroleum. If total U. S. domestic demand for petroleum and its products is plotted against the Federal Reserve Board Index of Industrial Production, it will be noted that U. S. petroleum demand turned down from that of the preceding years in only the 1930-32 period and in 1938, which were years of major turndown in industrial activity. In 1921 the reduction of industrial activity was only enough to flatten out the growth in petroleum demand. This was also the case in 1949, despite the warm weather.

As regards the forecasting of future business conditions, the paper stated: "In recent years progress has been made by economists in narrowing the range within which conditions will probably fall. A more disciplined and methodical approach to the problem of business forecasting has made the relations and correlations of economic variables stand out much more clearly. Useful techniques have been developed, with major factors broken down into their component parts and each of these components carefully analyzed. There remains, however, the necessity of making a number of basic assumptions, some of them primarily political in nature."

3—COMPETITIVE ENERGY SOURCES

With a few exceptions, the petroleum industry is primarily concerned with providing energy in liquid form and hence competition with other forms of energy is added to that prevailing within the petroleum industry.

In considering the repercussions of competitive fuels, natural gas was considered. Natural gas developments are in part reasonably predictable and in part not, the paper brings out. By following authorizations and construction schedules of gas pipelines, it is possible to determine the approximate increases of this fuel that will become available at specific periods and in specific places.

It has been shown that additional natural gas now scheduled to arrive in eastern and mid-western areas over the next 3 years is equivalent in heating value to about 480,000 b/d of fuel oil. Only part of this will replace fuel oil, with the remainder replacing coal or supplying added energy requirements. The division between these uses is only partly subject to analysis.

The fuel oil business, particularly in the east, has received an unexpectedly strong assist in recent months as a result of the labor difficulties in the coal industry. It is fortunate for the consumer that oil has been able to provide the necessary flexibility and step into the gap. The movements of residual fuel oil from the Caribbean and California to the East Coast have been invaluable in helping provide the required flexibility for the oil companies to meet this demand.

4—PSYCHOLOGICAL FACTORS

These are largely short-term influences. While sometimes helpful, they are in considerable measure responsible for taking a situation that might be reasonably satisfactory if averaged over a year's period and making it unsatisfactory by accentuating the swings between the high and low levels of operation. Psychological factors are often sharply influenced by other variable factors. For example, there is a real danger that the last two warm winters which have prevailed in the principal heating oil areas will unduly influence the thinking and planning for next winter's season.

A specific item about which too little is known but which is sensitive to psychological influences is the subject of secondary stocks, Mr. Cogan brought out. "Normal seasonal variations in these stocks do not constitute a problem," he said, "but the frequent departures from 'normal' do. The petroleum statistics with which the industry is accustomed to work cover inventories of products only at refineries and major bulk terminals.

"Factual information on stocks in smaller terminals, bulk stations and even consumers' tanks is very scanty. There is evidence, however, that the changes in these stocks represent very large volumes so that abnormal variations can be a real source of short-term trouble. One indication of the probable order of magnitude of these secondary stock changes can be obtained by analyzing the deliveries of heating oils from primary sources and comparing these volumes with the presumed actual consumption based on prevailing temperatures.

"From a study of this nature for the past 3-year period for the area East of the Rockies for kerosine and distillate fuels combined the conclusion has been drawn that fluctuations up and down in these stocks, or other unexplained seasonal variations, amount to at least 25,000,000 barrels over a season. It is thus clear that any single month or two may find results badly distorted by this factor."

Electrical Control of Air Line Burners In Thermofor Catalytic Cracking Unit

By JOHN M. CROTHERS, Catalytic Construction Co.

An electrical circuit design worked out for the control of the air line burners of a Thermofor catalytic cracking unit regenerator combines unique manual and automatic operating and shutdown features. Close regulation of the fuel gas supply is a necessity to eliminate the explosion hazard due to loss of flame or air pressure. Flame control is effected through a thermal conductivity device.

IN a modern refinery employing air line burners to heat air which regenerates spent catalyst from the Thermofor catalytic cracking process, the operating and automatic shutdown requirements present an interesting electrical circuit design.

An air line burner heats by direct combustion of fuel (generally gas) in the air stream to the regenerator. The air is heated to as high as 1100° F., and is maintained under pressure of about 2 psi. To eliminate explosion hazard, the controls are set to close the gas supply in the event of either loss of flame or loss of air pressure. In addition, an alarm circuit is provided to notify the operators of the condition which failed.

The major equipment is shown in Fig. 1. The automatic flame control is shown at *ER*. The primary element is an electrode located in the flame of a burner. This operates by conductivity of particles ionized in the flame. The main fuel valve shown at *L* is operated by a latch-type solenoid. This valve can be opened (manually) only when the solenoid is energized and it automatically closes when the solenoid is de-energized. The automatic flame control and the pressure switch shown at *PS* are hooked up through a system of relays such that either can close the solenoid in the fuel line.

The ignition system consists of an electrically ignited pilot burner which is inserted through a packing gland to eliminate danger of flashbacks when the air line burner is lighted. Gas to the pilot is controlled by a solenoid valve shown at *S*. The manual 3-way valve in the pilot feed line is used to vent excess fuel from the nozzle and solenoid valve.

The push button shown at *PB* is used to establish the spark which ignites the pilot flame. Convenience dictates that this button be located close to the main gas solenoid valve *L* and the manual burner valve *A*; since the operator must open these valves to fire the burner.

Red and white indicator lights are shown at *W* and *R*. Red is illuminated when the flame control electrode is not conducting. White is illuminated after the flame starts and the electrode becomes a conductor.

Firing of the air line burner is done at approximately 0.5 psi. air pressure. Higher air pressure tends to blow out the pilot flame. The basic requirement is that the burner must be ignited at below one psi. even though equipped with an automatic shutoff which will function when the pressure drops under one psi. The easiest solution is to provide a reset button to bypass the air pressure switch during ignition. This, however, is a hazardous expedient, since it would permit a careless operator to render the safety controls inoperative during burner operation by forgetting to reopen the reset button. The omission of the reset button became the critical point of the problem, and was solved by the use of a time-delay

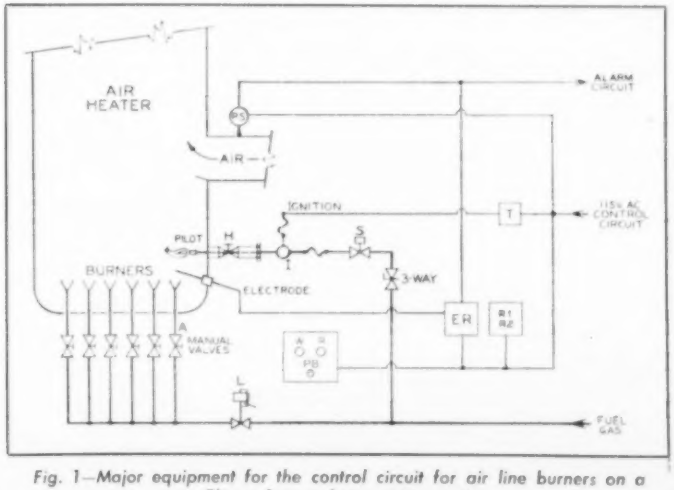


Fig. 1—Major equipment for the control circuit for air line burners on a Thermofor catalytic cracking unit

Meet the Author

John M. Crothers' responsibilities as an electrical engineer with Catalytic Construction Co. include both design and construction phases. With the firm since 1946, Mr. Crothers is a registered professional electrical engineer in the state of Pennsylvania. He received his technical education at Drexel Institute and Johns Hopkins University.

His engineering career began with the Philadelphia Electric Co. in 1924. In 1929 he became an electrical designer for Pennsylvania Power and Light Co. From 1933 to 1946 Mr. Crothers was a designer with Sun Oil Co.

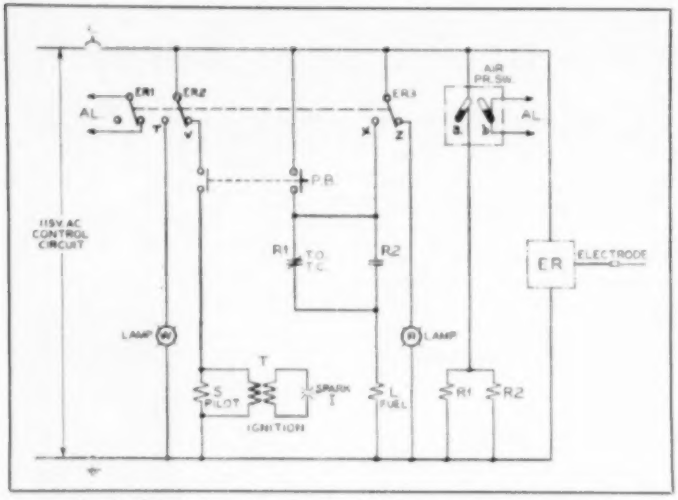


Fig. 2—Schematic wiring diagram for the air line burner control

opening and time-delay closing relay of the mercury port type.

This relay is shown as *R*1 on the wiring diagram of Fig. 2, which consists of a 115-volt, single phase, 60-cycle control circuit and a separate alarm circuit. Contacts *ER*1, *ER*2, and *ER*3 in the electronic relay equipment are actuated by the flame control electrode. Relays *R*1 and *R*2 are in parallel in the air pressure switch circuit. The contacts of these two relays are opposite in position, *R*2 being closed and *R*1 open when the circuit is energized. The function of the time-delay relay *R*1 can best be described by outlining the firing procedure for the air line burner.

The control circuit is shown de-energized with no flame and no air pressure. With the alarm circuit closed and the horn silenced, the annunciator indicates "NO AIR PRESSURE" and "FLAME FAILURE". The operator inserts the pilot over burner *A* and opens the three-way valve to the ignitor. The air pressure is raised to approximately 0.5 psi. and switch *C* is closed, energizing the control circuit, which condition is indicated by illumination of the red lamp through contact *ER*3-*Z*.

The operator then takes a position at the normally open two-pole momentary contact push button adjacent to valves *L* and *A*. The push button is then held closed, simultaneously opening pilot fuel solenoid valve *S* causing ignition spark to occur in the ignitor, and energizing the latch-type solenoid valve *L* through the closed relay contact *R*1. The pilot ignites and the operator manually opens valve *L*. The manual valve of burner *A* is then opened. When flame is established at this burner, the electrode circuit closes through contact *ER*3-*X*. Simultaneously, the electrode circuit relays remove "FLAME FAILURE" from the annunciator, ignition spark stops, and the pilot feed solenoid closes. The white light is illuminated and the red light is extinguished, indicating to the operator that flame is established and is now controlled by the electrode.

The push button can now be released, since the main gas feed solenoid valve is energized through the electrode circuit. The operation of opening valves *L* and *A* while holding the push button consumes very few seconds. If the flame is not indicated immediately on opening the valve *A*, the push button should be released, valve *A* closed and the system well purged with fresh air. The trouble should be investigated and corrected before attempting to relight.

Having burner *A* lighted, the operator opens the required number of additional burner valves to obtain the desired air temperature. These burners light from burner *A*. The pilot is withdrawn sufficiently to permit valve *H* to be closed. The three-way valve is turned to close the pilot gas feed and bleed excess gas from the ignitor.

When the air pressure is raised, the pressure switch circuit closes through relays *R*1 and *R*2. The alarm circuit opens removing "NO AIR PRESSURE" from the annunciator. On being energized, *R*1 opens and *R*2 closes. To avoid momentary interruption of the circuit holding open the main gas feed solenoid valve, *R*2 must close before *R*1 opens. This is accomplished by the time delay feature of relay *R*1 which remains closed one second after being energized, permitting *R*2 to close first. Now the flame failure contact *ER*3-*X* and air pressure contact *R*2 are in series and loss of either will automatically extinguish the burners by de-energizing solenoid valve *L*.

Loss of air pressure below about one psi. closes the alarm circuit and de-energizes relays *R*1 and *R*2, closing the former and opening the latter. In this situation, contact *R*1 must remain open for sufficient time to allow the flame to go out and the electrode to open the circuit. A four-second time delay in the closing of contact *R*1 keeps the circuit open for sufficient time to permit the mechanical mechanism of valve *L* to close and the electrode circuit to be opened by loss of flame.

It will be noted that either in the event of shutdown of the burner by loss of flame or by loss of air pressure, the contacts *ER*1, *ER*2, and *ER*3 reset to their original position for restarting.

The above installation has been in operation for many months and has functioned satisfactorily under various conditions.

IN APRIL—Survey of Graphic-Type Control Panels

Because of the widespread interest and activity being shown by the petroleum processing industry in the recent developments in so-called graphic-type instrument control panels, PETROLEUM PROCESSING is now conducting an editorial survey of both users and makers of such equipment.

Approximately ten installations of various types of graphic panels, involving several leading instrument manufacturers, engineering firms, and refining companies are at present already in use or nearing completion. Processing equipment covered by these panels range from individual units through general process areas to entire refineries. Some of these have been reviewed previously (See PETROLEUM PROCESSING: September, 1949, pp. 979-980; October, 1949, pp. 1097-1100; January, 1950, pp. 45-48).

An exclusive, staff-written article in the April PETROLEUM PROCESSING will present the findings of the present survey, tracing the historical background of the graphic panel to its present stage of development, and analyzing some of the problems still to be met in actual commercial applications. Watch for it!

Pure Oil's First Solvent Lube Plant Now in Operation at Smiths Bluff

By D. P. THORNTON, Jr.
Southwestern Editor

THE first solvent extraction type lubricating oil facilities which Pure Oil Co. has ever installed have recently been completed at the company's Smiths Bluff refinery near Beaumont, Texas.

Part of Pure's long-range postwar building and engineering program,* the new facilities include:

1) Two-stage Foster-Wheeler crude distillation, of 18,000 b/d capacity.

2) Propane deasphalting and phenol extraction, of 2600 b/d and 2900 to 5700 b/d design charge capacities, respectively, built by M. W. Kellogg.

3) MEK-benzol dewaxing consolidated with clay finishing of 2400 to 4200 b/d capacity, erected by Lummus Co.

In addition, the new facilities required expansion of plant utilities, notably two 150,000 lb./hr. Combustion Engineering boilers supplying 450 psi. 650° F. steam, sludge blanket precipitation-type water treaters and Zeolite softeners, all built by Stone and Webster. A 31,000 gpm. Fluor cooling tower was erected also.

Great flexibility in permitting rapid shifts from one lube stock to another, necessity for precise control to produce very close-cut fractions without further rerunning in making specification high-quality products and ability to use different crude stocks, are among the plant characteristics which most impress the visitor. After nearly a year's operating experience on some of the earliest completed units, Pure's engineers have encountered some interesting operating problems and are on the way to unusual solutions.

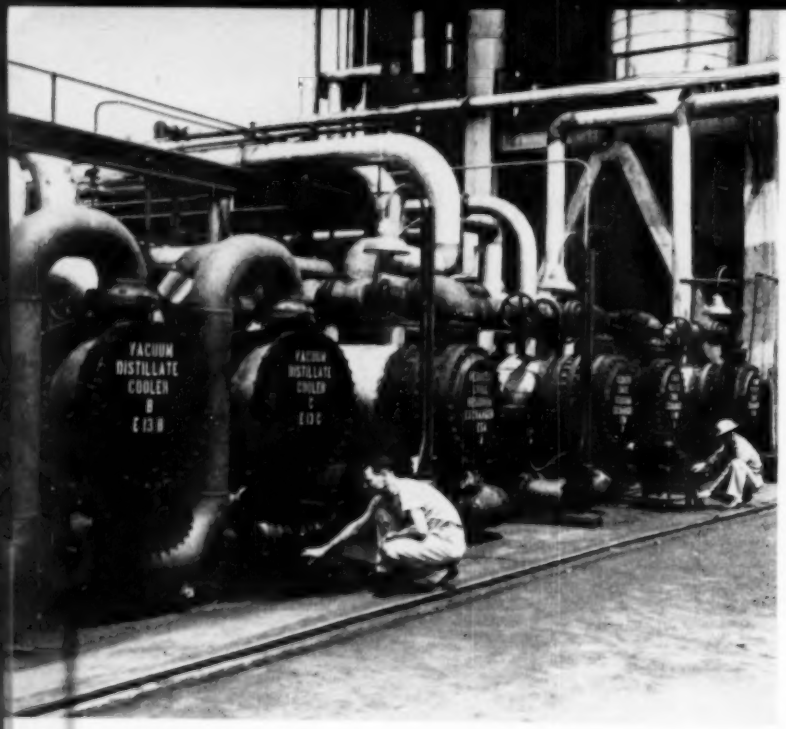
General view of the propane deasphalting unit at Pure's new lube plant, with solvent recovery tower in the background, at the end of the long line of exchangers. Immediately to the right of the solvent recovery tower is the phenol extraction unit. The control room for the deasphalting unit is in the left foreground, behind the row of exchangers. Note the general openness of the plant layout and the wide access roadway, planned to give ready accessibility of equipment for maintenance

Crude Distillation

Although the crude unit was designed to handle either Van or East Texas crudes, it is contemplated the unit will charge the former exclusively, since Pure, owning three-fourths of the production, purchases the entire field output and pipes it the 200-odd miles to Smith's Bluff. The crude has an excellent lube fraction.

The crude unit atmospheric column

* Other expansion projects recently completed by Pure include new catalytic cracking and feed preparation units at its Heath refinery, Newark, Ohio, and delayed coking and naphtha fractionation facilities at its Toledo, Ohio, refinery.



Line of heat exchangers in the new combination crude distillation at the Smiths Bluff refinery. The two exchangers at the left cool gas oil overhead (the third in the series is not visible), the next two heat reduced crude charge with vacuum bottoms, and the last two heat raw crude to the desalters against atmospheric tower bottoms

makes end-point straight-run gasoline overhead, with two narrow-boiling naphtha sidestreams, side-cut kerosine and virgin gas oil fractions, all meeting flash and end point specifications, and topped crude bottoms. The bottoms exchange against crude oil to the desalters and then are heated again as charge to the vacuum tower operating at 80 mm. Hg. absolute pressure (top tray).

Vacuum distillation produces more gas oil and four lube stocks, column overhead being predominantly water vapor and any fixed gases in the charge, gas oil reflux returning to the top tray. Two of the lube fractions are side-cuts of closely controlled boiling range so that, when subsequent solvent extraction and dewaxing are completed, the finished stocks will meet flash, fire and viscosity specifications for 100 and 170 vis. at 100° F. neutrals. The residuum bottoms are 1300 vis. at 210° F. as produced, corresponding to a finished bright stock of 150-160 vis. at 210° F. The third lube stock, the lowest sidestream, has a variable viscosity since the other streams off the unit are closely controlled. However, it generally meets requirements for 500 vis. at 100° F. (60-85 at 210° F.) neutral of 3 to 5 NPA color when finished. All stocks range from 90 to 100 V.I. or better when finished.

From here on all operations are in "blocks" or batches.

The deasphalting operation is entirely conventional and charges only the bright stock vacuum bottoms. The oil yield is approximately 60% of charge and the asphaltic extract is high melting point without the use of stripping steam. The asphalt is fluxed with gas oil and burned as plant fuel.

Solvent Extraction

The phenol extraction unit processes all lube stocks produced, being operated to produce either 90 or 100 V.I. stocks as needs dictate. Capacity ranges from 2900 to 5700 b/d with up to 10,000 b/d phenol circulation capacity. An average of 12 stocks monthly are extracted on this unit, processing periods ranging from as short as two days for non-viscous neutrals up to ten days on bright stock. In practice the size of a "block" is dictated by sales needs as well as storage facilities, there being intermediate tankage amounting to 10,000 bbls. for 100 vis. base stock, 30,000 bbls. for 170 vis. base neutral, and 30,000 bbls. for deasphalted bright stock.

Due to the frequency with which stocks change, the problem of minimizing insofar as possible the volume of crossover stock resulting from the shift has been the subject of considerable study by operating personnel.

An interesting routine has been worked out with reference to these switches to minimize crossover stock volume and time lost. Following the next turnaround, certain modifications will be made to permit an even further reduction.

An effort is made, when circumstances permit, to follow through with subsequent charges not greatly different in viscosity—i.e., 100 at 100° F. neutral is followed with 170 vis., then 500 vis., rather than with 150-160 bright, and the like. When a run is completed and fresh feed charging stopped, pumping begins at the interface between raffinate and extract phases until raffinate has been removed and the upper portion of the extraction tower is empty.

This has two advantages: First, as much as possible of the raffinate from the previous run is "saved" and does not go into crossover. Second, due to the naphthenic character of the charge stocks, an iron salt of either a phenol complex or naphthenic acid complex (perhaps both) is produced which is soluble only in the phenol-rich (extract) layer. This produces a reddish, lacy interface layer of appreciable thickness and also tends to settle out in the upper (raffinate) portion of the tower. Pumping out during switchover removes much of this material, thereby helping keep the tower cleaner.

After the raffinate layer has been entirely removed from the extraction tower, normal unit operation again commences, although it takes approximately three hours to get the tower entirely full of material again. A minor change in cooling water piping, scheduled for the next regular shutdown, will permit additional cooling of the phenol overhead from the raffinate solvent recovery tower and thereby reduce the net time "lost" when making a feedstock switch. It is hoped by this arrangement to reduce the net switchover time to approximately two hours.

In operations with larger batches of charge stocks, the crossover losses would not be large. Indeed, in some plants where feed batches are large or subsequently rerun, crossover mixtures would be lost in the comparatively much larger volume of finished stock, and no raffinate pump-out measures would be necessary. Pure, however, does not permit this mixture to occur, as it might seriously affect finished product specifications and complicate subsequent blending operations.

Dewaxing and Finishing

The final operation is dewaxing and clay finishing, combined for convenience in one area of the lube plant. Dewaxing is carried out in methylethylketone-toluene-benzol so-

lution at approximately —15° F. to yield an oil of zero pour test. This, like the preceding phenol extraction operation, is batchwise, with four rotary vacuum filters in parallel.

A fifth filter is provided for deoiling the by-product slack waxes and petrolatum to, in the case of petrolatum, a product having less than 2% oil and a melting point between 170 and 180° F. This latter operation commenced its shakedown run the first week in February and operations have not yet settled down to a normal routine. The Van crude is not excessively waxy, but contains from 12 to 18% wax, with a high proportion of high melting point petrolatums.

This unit is unconventional in that it does not use fired heaters in the solvent recovery step. Ample supplies of exhaust steam are available to vaporize the solvent. A small heater is used, however, to heat the oil for the clay finishing step.

Clay finishing adds the final "polish" to the oils. The equipment features an Oliver precoat rotary filter on the same level as the dewaxing filters; the clay used is 200 mesh Filtrol. The clay contact controls are located with those for dewaxing in a common control room and the process is conventional. All clay handling is accomplished pneumatically to minimize the dust problem. Passage through a blotter press assures that no clay remains in the finished oils. The spent absorbent is mixed with water and the resulting slurry is then pumped to a disposal pond.

Color of the 150 vis. (minimum) bright stock is approximately 7 NPA as dewaxed; following clay finishing it ranges between 4½ to 5 with a Conradson carbon of 0.5%. The 170 vis. at 100 neutral when finished has a color of 1½ NPA and carbon residue in the neighborhood of 0.005%. The 100 pale neutral is used generally for blending winter-grade lubes, the excess, with all of the 500 vis. neutral, being sold or blended as specialty oils. Finished lube tankage is protected with dry-air blanketing.

Grease manufacturing, blending and packaging of lubricating oil and compounding of specialty products are combined in a modern two-story building located between a new 1285 ft. double-deck deepwater dock and a railroad spur. Controls for all transfer pumps from finished oil storage are located here, together with elaborate manifolding, metering and blending equipment that feed either to grease kettles or the most modern of canning and drum-filling machines. Extensive use is made of conveyor systems and palletizing, combined with fork-trucks, for transporting empty and filled packages, drums and barrels. Connections from base and additive stock piping to blending and packaging machines are by flexible hoses. Capacity is sufficient to allow for considerable future expansion of base-stock production capacity.

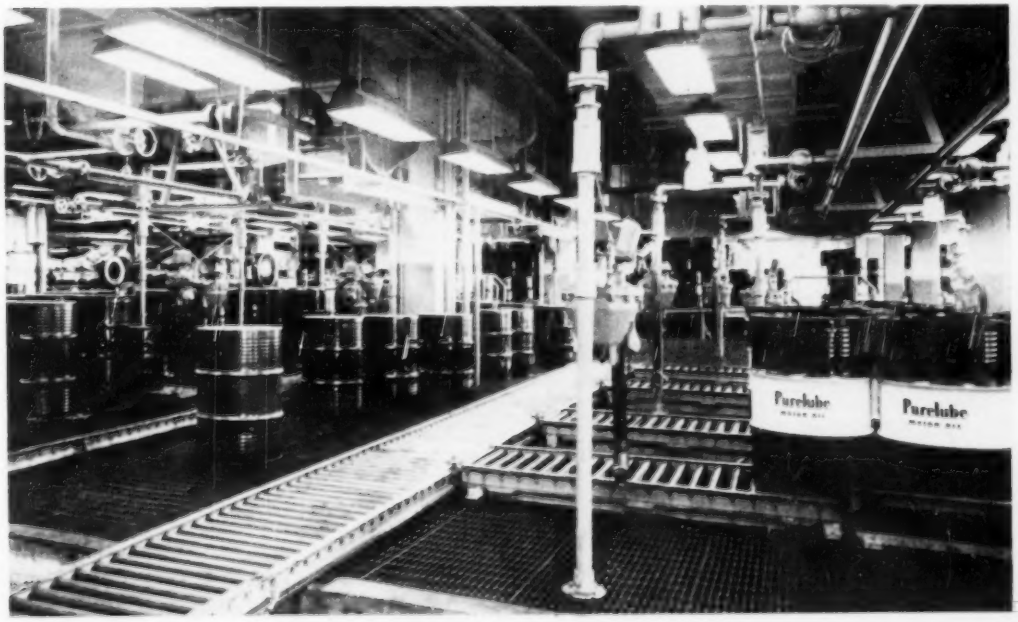
Extensive use of conveyors and palletizing is apparent in the blending and packaging plant, as indicated in this view of the drum and barrel section

Operating Problems

One of the problems which has faced Pure's technologists in operating the new lube facilities is the presence of naphthenic compounds in the crude as well as salt. Although Van crude has only 35 to 70 lbs. of salt per 1000 bbls. of crude, early operation of the crude distillation unit disclosed plugging tendencies which ultimately resulted in the addition of desalting equipment.

The naphthenic compounds present have given trouble because some at least are sufficiently acidic to cause extensive corrosive attack in both the crude distillation and solvent extraction units. Incoming crude to the distillation unit now is being pre-treated sufficiently with caustic, following desalting operations, to remove the more acidic naphthenic components. This has resulted in reduced corrosion in both crude distillation and solvent extraction units.

Further research is under way towards developing an economical crude pre-distillation treatment which will remove additional substantial quantities of these materials. This possibly may result in a valuable by-product chemical raw material with which to offset treating expense as well as mitigate corrosion and simplify operating problems.



Economic Handling of Caustic Soda With Variable-Area Flow Meters

By ARTHUR PATUREAU, Chief Application Engineer, Fischer and Porter Co.

Substantial savings to refiners in freight costs are shown through shipping caustic soda in the higher concentrations. Accurate dilution during tank car unloading is secured by means of a ratio flow controller, actuated by variable area meters. Typical automatic installations are described; for caustic dilution, for metering within a plant, for using caustic soda for neutralization purposes or pH control, and the like.

CAUSTIC soda is one of the chemicals widely employed in petroleum refining and other industries today. Ease and safety in transporting it in various unit quantities and concentrations make it the universal alkali. However, many users forego large savings in its purchase by overlooking the fact that 73% caustic may now be easily handled and accurately diluted by means of the variable-area (V-A) meter and its accompanying secondary instruments and controllers.

A carload of 73% caustic contains 46% less water than does the same tank car filled with 50% caustic. Therefore, in shipping 73% strength, fewer dollars go for hauling water. At present caustic soda prices and freight rates, a West Coast user who receives a carload of caustic soda a day may save $354,000 a year by purchasing 73% caustic instead of 50%, using the system explained below (see Table 3).

Dilution during the unloading operation is the key to this saving. A ratio controller is available at moderate cost, which will control the flow of dilution water within a fraction of a per cent of the caustic flow. Variable-area meters are used as primary measuring and transmitting instruments for both caustic and water streams. The flow impulses from these instruments are supplied to the ratio controller, which continuously and accurately proportions the water flow rate to any caustic flow rate. An installation of this sort has the advantages of low pressure drop, high sensitivity, immunity to viscosity changes, and corrosion resistance. The linear flow scale characteristic of the V-A meter simplifies the design of the ratio controller since no square root functions are involved.

Further savings, but small in magnitude, are obtained by installing V-A meters at other points within the plant where flow of caustic soda must be measured and controlled. Fig. 1 is a typical "Flowrator" variable area meter for caustic service.

Economics of 73% Caustic

The V-A meter can handle any caustic flow under any process conditions. By installing a combined meter-and-instrument team at the unloading platform, and immediately diluting the 73% caustic to exact storage concentration as the caustic is unloaded, caustic savings begin before the tank car reaches the plant.

Under present market conditions, the caustic manufacturer gets $0.10 per 100 lbs. for additional processing in evaporation of the caustic from 50% to 73% concentration (see Table 1). Were it not for greater differences in the other direction in shipping costs, basic cost would favor use of 50% strength. However, the comparative freight rate tables alter the story somewhat.

Shipping costs on transporting a caustic tank car of 10,000 gals. are the same whether the car is full of solid caustic or full of water. Therefore, from a shipping cost standpoint, it is cheaper per pound of 100% caustic delivered to ship 73% concentration than to ship 50% concentration caustic.

By comparing the equivalent shipping costs per 100 lbs. of solid caustic (in Table 2) with the relative raw material costs of the two concentrations f.o.b. the alkali plant, it is clear that the $0.10 additional cost of 73% concentration over 50% is more than compensated by the saving of shipping. This is true even in Wilmington, Del., relatively near a source of supply. Table 3 gives an extension of savings to be realized through the use of 73% caustic with accurate means of dilution at the unloading station.

Diluting 73% Caustic

Caustic of 73% concentration is a solid at normal atmospheric temperatures; consequently, in transit and in storage its temperature should never be allowed to drop below 147° F. Since it is shipped in cars equipped with steam coils, the contents of the car as it is unloaded should be held from 180° to 210° F. At this temperature range the viscosity will vary only from 16 to 10 centipoises, well within the viscosity immunity range of some V-A meters, at flow rates customarily used during unloading.

The flow diagram, Fig. 2, shows a typical automatic caustic dilution installation employing V-A meters, pneumatic transmitters, and a ratio controller. The flow of caustic proceeds from the tank car through an

TABLE 1—Caustic Soda Prices

(FOB Shipping Point in Carload Lots)

	$ /100 lbs. of 100% Conc.	
	Commercial Grade	Rayon Grade
50% Caustic	2.40	2.50
73% Caustic	2.50	2.60

Meet the Author

Arthur Patureau is completing his second year with Fischer & Porter Co., Hatboro, Penna., as chief application engineer. A native-born Texan, he received his Bachelor of Science in Chemical Engineering at The University of Texas at Austin. Prior to his association with Fischer & Porter, Mr. Patureau was chief process engineer for Fomac Engineers, identified with McCarthy Chemical Co., Houston. He also served in the same capacity with Gasoline Plant Construction Corp., Corpus Christi, Tex. An active member of the American Institute of Chemical Engineers and the Instrument Society of America, Mr. Patureau spends his spare time supervising a small farm in Pennsylvania.

TABLE 2—Caustic Soda Freight Rates

(Current freight costs per 100 lbs.—100% sodium hydroxide)

Destination	Liq. Caustic Rate	73% on Solid Basis	50% on Solid Basis
Atlanta, Ga.	$0.4028	$0.5518	$0.8056
Wilmington, Del.	.3498	.4805	.6956
Omaha, Neb.	.5250	.7192	1.0500
San Francisco, Calif.	1.6432	2.2509	3.2864

The above are equalized rates from the nearest producer.

unloading pump. Some installations use air to "pad" the tank at a pressure great enough to force the liquid caustic through the system, thus eliminating the need for a pump. The low pressure drop across the V-A meter permits its use in either type of unloading system. From the caustic meter (which may be located on either side of the pump, dependent upon the gravity head available) the fluid passes through a mixing wye, thence through the caustic cooler, and directly into the caustic storage tank.

When a pump is used, a centrifugal type is customarily installed, completely iron-fitted (preferably a nickel cast iron). Pumping rate will depend upon the time available for unloading, but a flow of 100 gpm. is an acceptable rate for this service. The water required for 10,000-gal. carload for dilution from 73% to 50% concentration will be:

$$\frac{10{,}000 \times 1.7 \times 0.73 \times (.73 - .50)}{.50}$$

5,700 gals.

Unloading time at 100 gpm. will be:

$$\frac{10{,}000}{100} = 100 \text{ minutes.}$$

Dilution water rate will be: 5700/100 = 57 gals./min.

The water must be furnished at a pressure not less than the discharge pressure of the unloading pump. When the unloading operation has been completed, the unloading pump may be used as a recirculating and transfer pump.

The caustic rate is measured through a meter equipped with a magnetic clutch and a unique magnetic linkage with the completely enclosed float extension. This transmitter senses and transmits float position (and, therefore, flow rate) without such mechanical equipment as seals, glands, or stuffing boxes. Within the all-nickel meter housing the only moving part is the completely enclosed nickel float, which travels a maximum of 5 in. vertically in accordance with the rate of flow.

In this manner the corrosive nature of high-concentration hot sodium hydroxide is completely confined within materials which are most resistant to its corrosive action. The transmitter requires only the usual instrument supply air; no electricity is needed. Fig. 1 shows a cutaway view of this arrangement.

A similar meter is employed for the dilution water service, but this meter has steel fittings, a stainless steel float, and a pyrex metering tube. A magnetic clutch and pneumatic transmitter is also used to transmit water flow impulses.

The linear flow scales of the caustic and water primary instruments allow direct ratio control to be effectively applied to govern the flow of water in accordance with the flow of caustic from the tank car. The ratio controller will maintain a constant proportion between the two streams regardless of the rate of flow of the caustic. This ratio is continuously adjustable over the full range of both flow meters. The ratio controller may be fitted with pneumatic receivers and a spring-wound chart drive to give a complete economical explosion-proof dilution system for hazardous unloading areas where flammable materials also are unloaded. Electrical and electronic transmission systems are also available for this service, in both explosion-proof and non explosion-proof construction.

It has been general practice to provide a cylindrical measuring tank for the purpose of determining volumetrically the amount of water to be added to a given quantity of caus-

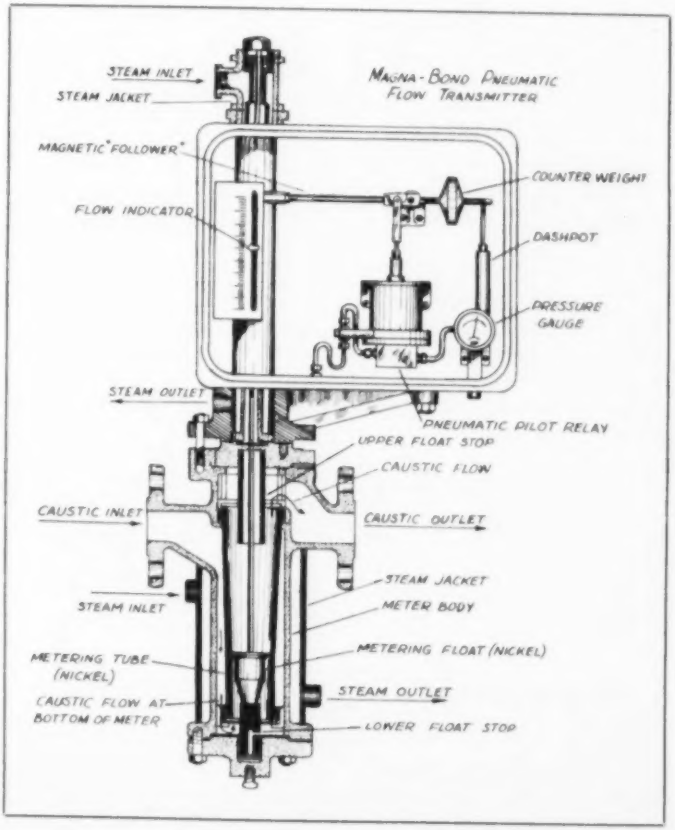


Fig. 1 — Right: Typical variable-area flow meter for caustic service. Magnetic follower transmits signal from alloy primary element to the pneumatic pilot relay

tic. Besides the cost of building such a tank and supporting it at a level above the caustic storage tank to provide gravity flow, this procedure demanded that an operator be in attendance at the metering tank almost constantly. This procedure is eliminated by using the system illustrated in Fig. 2 because the ratio controller is designed for "hands-off" control. The accurately diluted solution goes through the heat exchanger and directly into the storage tank, eliminating entirely the need for an intermediate measuring vessel.

Storage of Caustic Soda

Caustic is generally stored economically within the industrial plant at 50% concentration. At this strength, freezing is not encountered at temperatures above 65° F. If outside storage is used, a steam coil within the tank serves to maintain the solution in a fluid state in any weather. The minimum storage capacity is usually set at from 1½ to 2 tank carloads of diluted caustic. The amount of storage capacity required is a combined function of the rate of use and the rate of movement of caustic rail shipments from the caustic supplier.

A convenient method of further diluting caustic within the plant for intermediate storage or direct use is shown in Fig. 3. In this system, the 50% (or storage concentration) caustic is diluted to the strength required by the process in sufficient quantity, as it is used, to maintain a level in the caustic "feed" tank. The demand by the process and a consideration of the minimum holdup time desired in the feed tank will dictate the size of this vessel.

The flow of caustic into the tank is governed by a control valve on the strong caustic line actuated by a float-type liquid level control on the feed tank itself. Since the flow of water is dependent upon the flow of caustic through linkage with the ratio controller, the flow of water stops automatically when the caustic flow stops. This system eliminates the need for distributing the water in volumetrically measured amounts, and the necessity for an operator's standing by waiting for the level in the tank to reach specified levels before changing or shutting off the flow. It is a continuous process.

Referring to Fig. 2: by a simple piping and valving arrangement, the unloading system may also be used for simultaneously diluting the storage caustic down to process strength and transferring it automatically to the process caustic feed tank. Such an arrangement necessitates a check of the process requirements prior to unloading to make sure that sufficient intermediate-storage caustic is available to the process during unloading and dilution of the new tank car. This installation is the most economical if physical locations of the various storage tanks permit. Fig. 4 shows piping arrangement for this combined system.

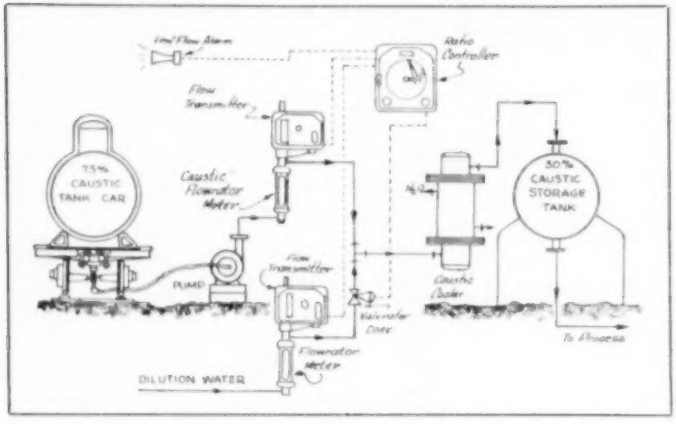


Fig. 2—Flow diagram of 73% caustic soda unloading system

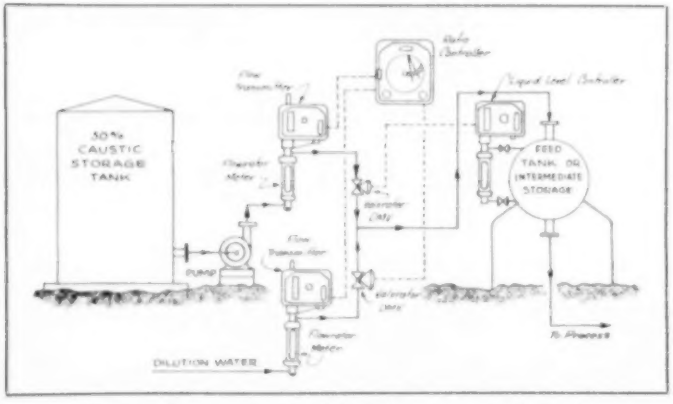


Fig. 3—Dilution system for intermediate storage of caustic

Metering Caustic in the Plant

The simplest form of caustic metering is an indicating V-A meter installed at the point of use. By means of a globe or needle valve, the flow of caustic may be manually held by the operator at the desired rate. This type of installation is no more complicated than installing a vertical length of pipe. No orifice flanges, no straight runs of pipe, no pressure taps or seal pots are required. The operator actually "sees" the flow. Metering tubes may be graduated in terms of the units used in the process: cubic feet per hour, gallons per minute, cubic centimeters per second—or any rate of flow units. Some ion exchange processes prefer "gallons per minute per square foot of bed surface area", which may be inscribed on the metering tube also, if required.

Best point of installation is in a well-lighted location, with the meter at eye level. This detail should be checked particularly in the design of new plants, to insure full benefits from the basic advantages of visual meters.

For processes requiring a number of caustic lines, a convenient arrangement is shown in Fig. 5. Here, a bank of indicating meters has been set up, each meter with its control valve located beneath its scale. Such an arrangement allows a quick check-up on the total caustic being fed into the process, and often reduces the number of pumps required for caustic service. Panels may be ordered completely assembled or may be constructed in the plant. These are usual-

TABLE 3—Savings in Shipping 73% instead of 50% Caustic Soda

Concentration, %	Atlanta, Ga.		Wilmington, Del.		Omaha, Neb.		San Francisco, Cal.	
	50%	73%	50%	73%	50%	73%	50%	73%
Matl. cost/100 lbs., $*	2.40	2.50	2.40	2.50	2.40	2.50	2.40	2.50
Frt. cost/100 lbs., $*	0.8056	0.5518	0.6996	0.4805	1.0580	0.7192	3.2864	2.2509
Total cost/100 lbs., $*	3.21	3.05	3.10	2.98	3.45	3.22	5.69	4.75
Net savings/100 lbs., $ (73% vs. 50%)		0.16	...	0.12	...	0.23	...	0.94
Net saving/10,000 gal. carload, $**		165.00	...	124.00	...	237.00	...	968.00
Yearly net saving, $								
(1 carload/month)**	...	1960.00	...	1490.00	...	2840.00	...	11,620.00
(1 carload/wk.)**	...	8580.00	...	6450.00	...	12,300.00	...	50,400.00
(1 carload/day)**	...	60,200.00	...	45,200.00	...	86,500.00	...	354,000.00

* Weights given refer to 100% sodium hydroxide.

** The savings shown are based on carloads of 73% caustic used, and do not include savings resulting from handling fewer railroad cars. "Spotting" and switching costs, demurrage, and unloading costs all go down proportionately with the use of stronger caustic soda.

ly constructed and shipped in a single container in such a manner that only electrical and air connections, one caustic inlet, and one caustic outlet for each meter are required. If the panel is not desired, the meters may be wall-mounted by the plant instrument department. Installations such as these provide an attractive appearance and promote good housekeeping within the plant. Because of the compact arrangement greater operation and records efficiency is secured.

In some processes where caustic must be metered *and* controlled, panel-mounted instruments and cabinets may be supplied as complete units. As with indicating meters these also may be grouped or installed singly as required, and they may be located some distance from the primary instrument. Centralization of these instruments provides both operator and management with a more complete, continuous knowledge of the process operation.

Neutralizing and pH Adjustment

In using caustic for neutralization purposes or pH control, the simplest method utilizes an indicating meter with manual caustic control and periodic sampling of the main line. This method is used where great degree of accuracy of pH control is not required, where there is extremely small variation in flow and pH, or where the utmost economy is desired. This is shown in System A, Fig. 6.

System B presents a slight refinement, that of adding a continuous pH indicator to the system. The control of caustic remains manual, however.

In System C, a flow controller has been added to the caustic line. Such an arrangement is a necessity where the pressure in either the caustic or the main stream fluctuates appreciably. By applying a sensing mechanism to the caustic stream, together with reset, assurance is built into the process that the caustic flow will remain constant regardless of the change in other variables. Shown in the diagram is a conventional pH glass-electrode-element continuous indicator and V-A meter with an integral flow rate controller.

In System D, a pH recording-controller is employed to operate the caustic air-operated diaphragm motor valve directly. A recorder is shown mounted integrally on the meter body. A remote recorder may also be installed.

System E employs remote recording and controlling of pH and caustic flow. The pH controller, equipped with a pneumatic control element, actuates a receiver which adjusts the set-point of the caustic recording controller. By this means the control of the entire system is invested in the control knob of the pH instrument, which senses changes in pH and accordingly changes the control point of the caustic line. Either or

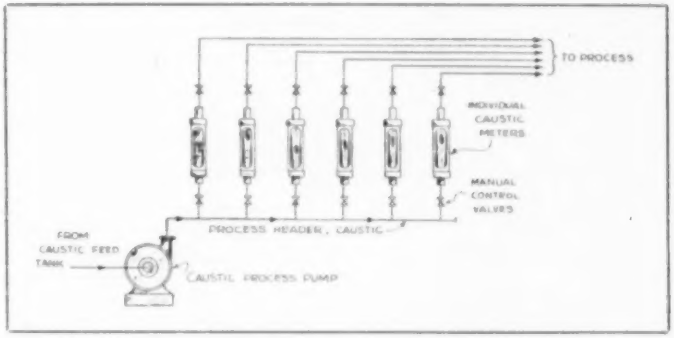


Fig. 4—Complete caustic unloading and dilution system

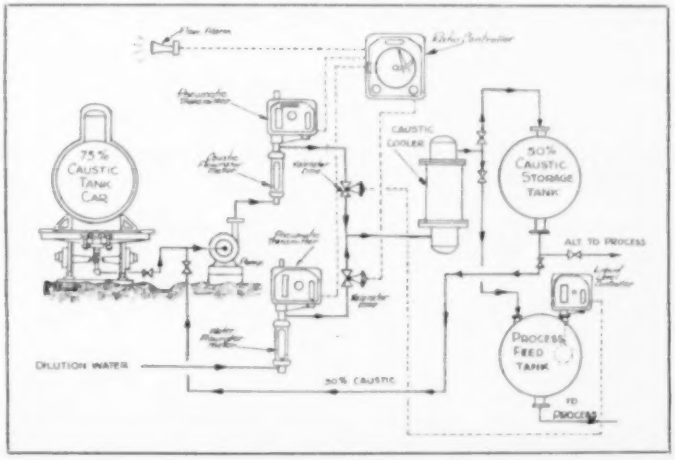


Fig. 5—Battery of caustic flow meters for a process unit

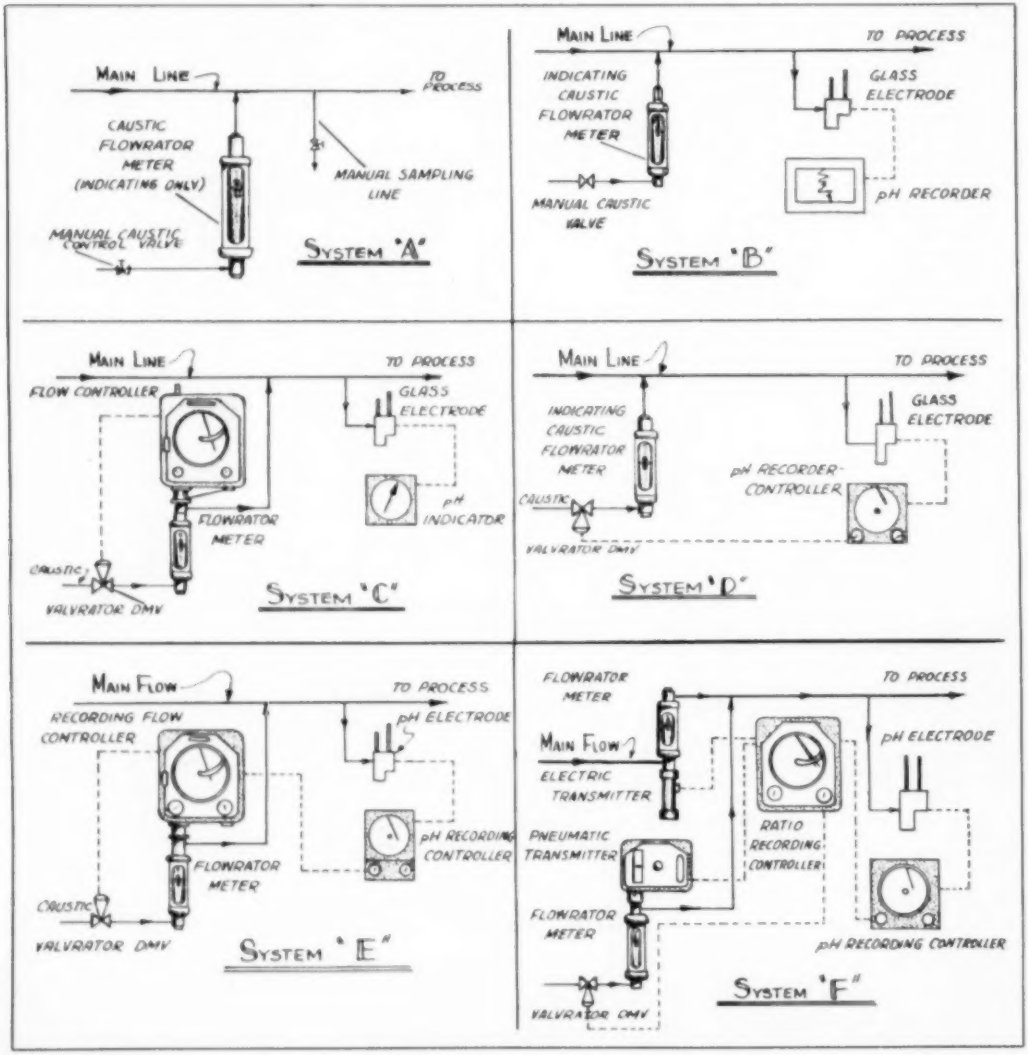
both controllers may be located on a panel remote from the location of the primary measuring devices.

System F is excellent for systems where 1) there are large and rapid fluctuations in the main stream, 2) there is a linear relationship between caustic and main stream flow, and 3) a record of the main stream flow must be tied into the system. A ratio controller closely governs the flow of caustic as a linear function of the flow of the main stream. The ratio between these two flows is constant for any setting of the ratio dial. The response from the V-A meters is instantaneous, so that any increase or decrease in the main stream flow is immediately reflected in the flow of caustic—and in the same ratio. The duty of the pH controller then becomes that of sensing the change in the relationship of the caustic and the main flows with respect to the pH valve, and making a change, through pneumatic means, of the ratio setting.

Fig. 6—Six different systems for using variable area flow meters in caustic pH control. For detailed explanation, see text

This system is the most automatic of all those presented and offers the most accurate control with least attention from the operator.

The illustrations on pH systems are schematic only and do not show all equipment which should be included for good pH measurement. Where conditions permit, in the optimum piping and equipment arrangement for pH measurement and control, a vessel should be provided equipped with good agitation to provide holdup time and "averaging" action on the reaction between the caustic and main stream.



CORROSION---

Damage to Interior Of Vessel Walls From Hydrogen Blistering Studied

A STAFF REPORT by the Editors of Petroleum Processing

THE nature of the damage to the interior of steel vessel walls from hydrogen blistering is being studied in the laboratories of the Standard Oil Co. (Ohio), at Cleveland. The interior damage from this form of corrosion may be considerably more extensive than is indicated by the surface evidence, it has been learned.

This information, together with data from other refineries, was supplied PETROLEUM PROCESSING by the oil companies, to bring additional light on the effect of this type of corrosion on vessels and other equipment, following the presentation of a report on the subject at the 1949 annual meeting of the Refining Division, American Petroleum Institute.

That report[1] represented an effort by the API Sub-committee on Corrosion of Refinery Equipment to assess the seriousness of the blistering and embrittlement of walls of vessels and other equipment from hydrogen released as the equipment corroded. Affected units were found in a variety of installations handling sour crudes, sour crude fractions, sour natural gases and gasolines, phenol, sulfuric acid, and mixtures of hydrocarbons and hydrofluoric acid.

Acid corrosion that releases atomic hydrogen appears to be a requisite for blister formations, it was reported. Hydrogen sulfide, being present in many refinery processing operations, is believed to be one of the corrodents most responsible for blister formation. The hydrogen sulfide, it was stated, may serve in a dual role in blister formation. First, in aqueous solution it behaves as an acid solution and during corrosive attack will release atomic hydrogen. Second, it may be a "promoter" that increases the rate of hydrogen penetration into steel. Cyanides were also reported present in some streams that blistered equipment and are suspected of being another "promoter" of hydrogen absorption.

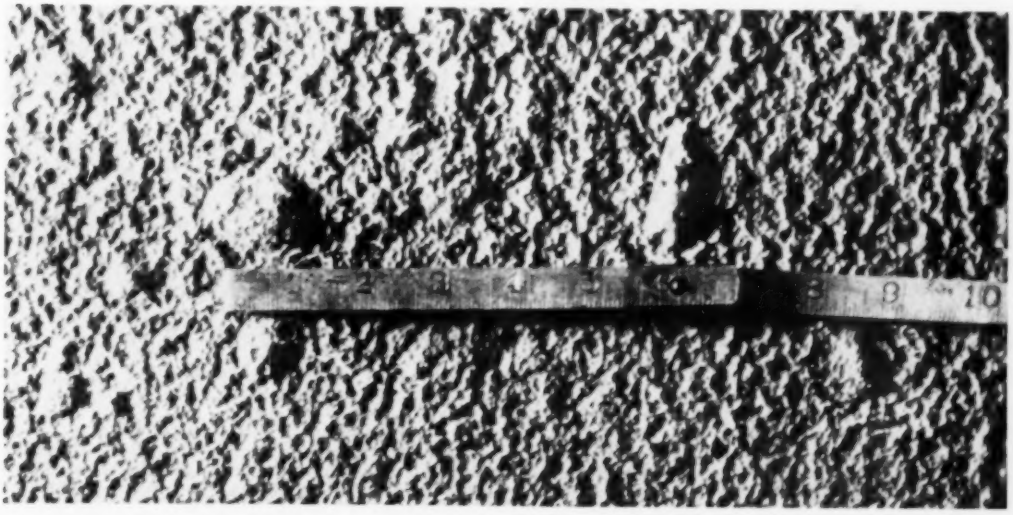
Closeup view of small hydrogen blisters found on the inside surface of a poly-feed accumulator vessel. (Atlantic Refining Co. photograph)

The same conditions that cause steel to blister may cause it to become brittle, the API report brought out. Cases of severe embrittlement brought to the committee's attention were limited to high strength steels. Hydrogen embrittlement of the low alloy carbon steels used for pressure vessels, piping and structural purposes in refineries and gasoline plants was not found to be a serious problem.

The method of hydrogen attack of steels at high temperatures was found to be distinctly different from that at low temperatures. At high temperatures the diffusing hydrogen will react with carbon and other nonmetallic impurities. Methane and other insoluble gaseous products will form and collect at grain boundaries at high pressures to embrittle and otherwise impair the mechanical properties of the metal. Reactions of this sort do not occur, and steels are not decarburized, at low temperatures.

New Data from Ohio Standard

The additional information on the possible seriousness of internal damage from hydrogen blistering con-



tributed by Standard of Ohio covers the laboratory examination of the blistering of a distillate debutanizer overhead condenser. It was indicated that the shell material was about 73% as strong as sound shell material and only 32% as ductile. The loss in strength was attributed to cracks perpendicular to the plate, rather than laminations parallel to the plate. This reasoning, it was stated, comes from the fact that formulae for calculating the maximum stress for both thick-walled cylinders and multi-layer cylinders are identical. A company report stated:

"The investigation disclosed that portions of the plate which appeared to have been merely attacked at the surface, that is, actual blisters had been raised above the surface of the metal, showed considerable cracking into the plate. This type of attack has been found in two or three other locations and will require further investigation by our refinery inspection personnel.

"In order to check on the progress of this type of attack, we have recommended to the Inspection Department that, in those cases where blisters have been formed and are easily seen, the thickness of the external laminations be determined by test plug measurements, Audigage readings or trepan plugs if necessary. This assumes that blistering and cracking is worst on the interior of the vessel in contact with the corrosive agent. It also assumes that the external lamination will carry the stress due to internal pressure. Possibly the drilling of the test plugs is preferred, since any gas pressure would be relieved and would thereby reduce the tendency to crack the blister edges due to triaxial stresses.

"Where blistering occurs as a surface defect, it has been suggested that a magnaflux inspection be conducted on the cleaned interior surface to locate cracking. It would be necessary to determine the depth of the cracks by grinding or chipping out the sound material or by taking trepan specimens.

"We are endeavoring to determine the inspection frequency of vessels known to be blistered or which are subject to blistering due to operating conditions. It has been suggested that pressure gauges could be installed in the reinforcing pad telltale holes in an effort to determine where blistering was likely to occur."

General Petroleum's Experience

Supplemental data to case histories of hydrogen blistering and embrittlement in vessels in its Torrance, Cal., refinery given in connection with the original report[2] were supplied by General Petroleum Corp. of California:

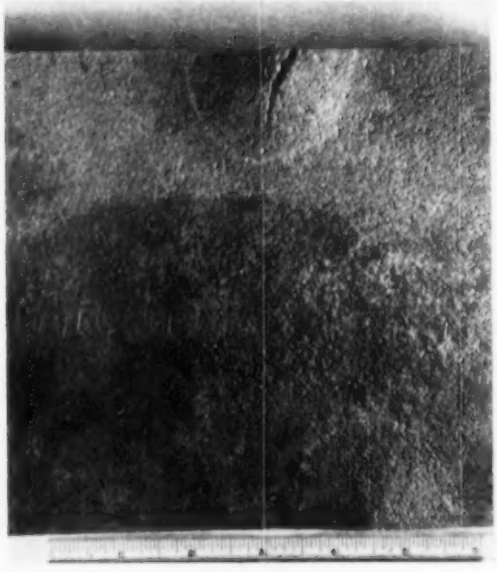
Gas Absorption Plant-Rich Oil Fractionator Reflux Accumulator: Original vessel replaced in April, 1945, because of a severely blistered head, as previously reported. Inspection on May 31, 1949, revealed blistering in the new vessel. Several blisters were found in each of two shell courses in an area up to two feet above the trough of the vessel.

The blisters were few in number, a maximum of 1¾ in. in diameter, about ¼ in. below the inside surface, and not high enough to cause cracking. The two plates blistered were Carnegie-Illinois steel heat No. 520,-671, slab 1-2, with chemical analysis of .23 C, .50 Mn, .014 Ph, .027 S (A-70 FBX). No repairs were made but the inspection interval was shortened to six months.

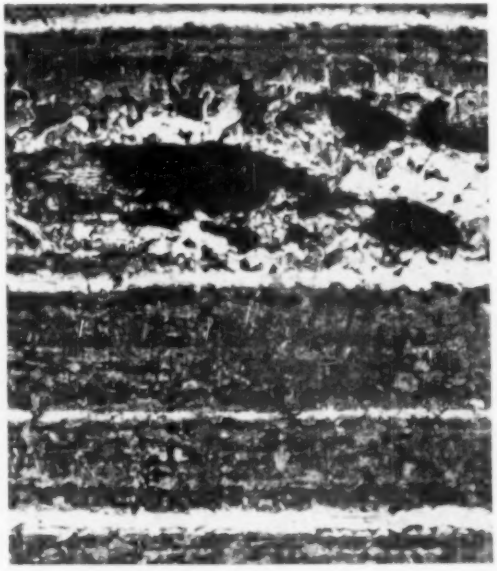
H. F. Alkylation Unit-Acid Dump and Blowdown Tank AF2A: This 10-ft. O.D. x 50-ft. tangent length vessel was put in service early in 1944. Shell plates and heads (S.E. 2:1) are of 1-in. ASTM A-70 FBX steel. Service is evacuating, venting and dumping from acid section of alkylation unit.

Inspection of Feb. 14, 1949, disclosed 6 small (¼-in. to ⅜-in. diam.) blisters in one shell course. Tapping the blisters with a hammer indicated they were very near the internal surface of the plate. The blistered steel was Carnegie-Illinois heat No. 60,462, slab 4-2, with chemical analysis of .21 C, .45 Mn, .010 Ph, .031 S.

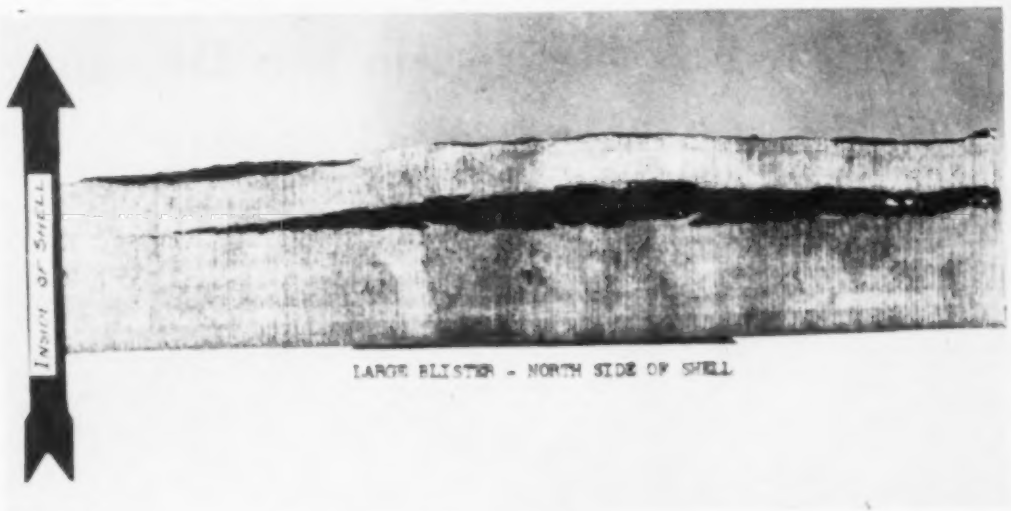
H. F. Alkylation Unit-Acid Settler: This 10-ft. I.D. x 50-ft. tangent



Section of large cracked blister on inside surface of rich oil fractionator reflux accumulator in gas absorption plant at Torrance, Cal., refinery of General Petroleum Corp. Note small cracks in dome of blister



Microstructure (about 150X) of blister shown at left. Etched with Stead's reagent, severe banding is shown, believed due to phosphorus segregation. (Phillips Petroleum Co. photographs)



Cross section of large blister (4 in. diam.) on inner surface of poly-feed accumulator tank, 5/16 in. to ⅜ in. below inside surface and part of a continuous lamination extending about 48 ins. circumferentially and 24 ins. longitudinally. (Atlantic Refining Co. photograph)

length vessel was put in service late in 1944. Shell plates and heads (S.E. 2:1) are of 1-in. ASTM A-70 flange quality plate. The vessel serves as a settler for products from alkylation contactors. HF acid settles out and is recharged to contactors from vessel bottom and hydrocarbons go overhead to surge tank.

Inspection of June 16, 1949, revealed numerous small blisters along the trough of shell courses Nos. 2, 3, and 5 as numbered from the north. The blisters were up to ½-in. in diameter and very shallow below the internal surface of the metal. Many had cracked, allowing corrosion of the blister so that only small pits remained. Blistered plates are Carnegie-Illinois heat No. 38,423, and slabs 3-2, 5-2 and 1-2, having a chemical analysis of .21 C, .42 Mn, .012 Ph, .033 S. Two other plates of the same heat, but slab 2-2, have not blistered to date.

Gas Fractionation Section—Raw B-B Storage Sphere 28x5: Vessel, put in service in 1943, is a 31-ft. O.D. sphere, with 1¼-in. shell plates, designed for 135 psi., and 0.033-in. to 0.10-in. corrosion allowance. Material is ASTM A-70 flange quality steel. Used for storing raw B-B at ambient temperatures (60° - 80° F.) at between 95 and 105 psi. H_2S content of raw B-B charged is 1.5% by volume. H_2S content of vapors at top of sphere: 6.5% by volume. Blisters discovered in 1948, as previously reported. Inspection of the vessel about 7½ months after the first discovery of blistering revealed the following:

1—No new segments or sheets blistered.

2—Of 12 segments containing blisters, only three showed any noticeable change. In these three, the total area affected had increased, there were more blisters and many of the old blisters had increased in diameter.

3—Cracking of blisters arrests their growth.

The vessel was returned to temporary service with the next inspection scheduled for an early date.

Gas Fractionation Section—Raw B-B Storage Sphere 28x4: The July, 1949, inspection disclosed no new areas affected since the findings of November, 1948, as earlier reported.[2] Only one of the four blistered segments showed any change. Here there were five large (5 to 6 in. in diameter) blisters in an area where only one was found before. This vessel was also returned to temporary service.

Shell Oil Reports

Shell Development Co. reported its attention had been called to cases of hydrogen blistering in the Wilmington-Domingues refinery, near Long Beach, Cal. The two vessels in which blistering was observed were the tops condenser shell at a P.D. stabilizer plant and a flash acumulator tank at the propane-propylene plant. In both vessels the blisters were small and well scattered, none being more than ¼-in. in diameter and none extending more than ⅛-in. below the surface. A second, later inspection of the flash accumulator vessel showed no increase in the number of the blisters or in their size. The blistering was not considered of significance and the vessels continued in service with no repairs contemplated.

Operating conditions of these vessels are as follows: The tops condenser shell (of carbon steel) operating at 130° F. and 100 psi., handling B.B. and lighter containing 4% H_2S. This vessel has had a service life to date of 20 years. The flash accumulator tank (ASTM A70 flange quality steel) operating at 100° F. and 100 psi., handling B.B. and lighter with 4% H_2S. Service life of this vessel to date has been 12 years.

Two Cases at Continental

Continental Oil Co. reports two more cases of hydrogen blistering since its last report[2], both of a relatively minor character and both occurring at the alkylation unit.

1—Several shell blisters approximately ¼-in. diam. were found on the inside surface of the No. 3 contactor shell from 2 ft. to 6 ft. above the bottom seam. This vessel contains a butane mixture and HF and operates at 125 psi. and 175° F.

2—About 25 small blisters measuring from ¼ in. to ⅜ in. diam. were found on the outside surface of a debutanizer reflux drum. This drum contains a mixture of butane, isobutane and a trace of HF and operates at 100 psi. and 130° F.

References

(1)—"Hydrogen Blistering of Steel a Source of Damage to Vessels", M. H. Bartz and C. E. Rawlins, Phillips Petroleum Co., PETROLEUM PROCESSING 4, 8, p. 898 (1949).

(2)—Case Histories of Hydrogen Blistering and Hydrogen Embrittlement, PETROLEUM PROCESSING 4, 8, p. 901 (1949).

Topography Figured in the Design Of New Montana Refinery

By D. P. THORNTON, Jr.
Southwestern Editor

LATEST design in fluid catalytic cracking and vacuum distillation units, and also unique features dictated by the topography of the location, are included in the new Carter Oil Co. refinery at Billings, Mont. Four months operation of the $17,000,000 plant, rated at 22,000 b/sd, one of the largest in the Rocky Mountain states, indicate that the design standards without exception have been met or exceeded. The refinery was constructed by Fluor Corp., Ltd., with process design by Universal Oil Products and Standard Oil Development Co.

The Billings plant is one of the few refineries in the country to use raw river water for cooling which has to be heated in winter to prevent freeze-ups. Contrary to usual cold-climate practice, everything is out in the open, from boilers and process pumps to control instruments. This reduces explosion hazards as well as construction costs.

Opposite to past conventional construction, relative elevations of reactor and regenerator in the cracking unit are reversed. The plant charges heavy sour crudes which require liberal use of alloys for corrosion resistance, chemical injection to protect heaters, and special provisions to desulfurize products afterwards, all of which influence the investment cost.

Built in an area noted for high winds and constructed to meet No. 1 Earthquake Zone Code requirements, every item of equipment is designed to withstand 100 m. p. h. winds. All small towers are sway-braced and guyed, and all foundations are set on reinforced concrete piling driven into the gravel bed underlying the site.

Special pains were taken to locate the plant advantageously with respect to rail facilities and water. One of the principal factors governing selection of the site 3 miles northeast of Billings was special U. S. Weather Bureau data indicating prevailing winds there would carry any escaping odors from sour crude or processing away from the city. It will be one of the few refineries to use a rotary kiln to burn chemical and sludge wastes for disposal, as soon as the balance of equipment items are delivered and assembly completed.

The refinery charges a mixture of

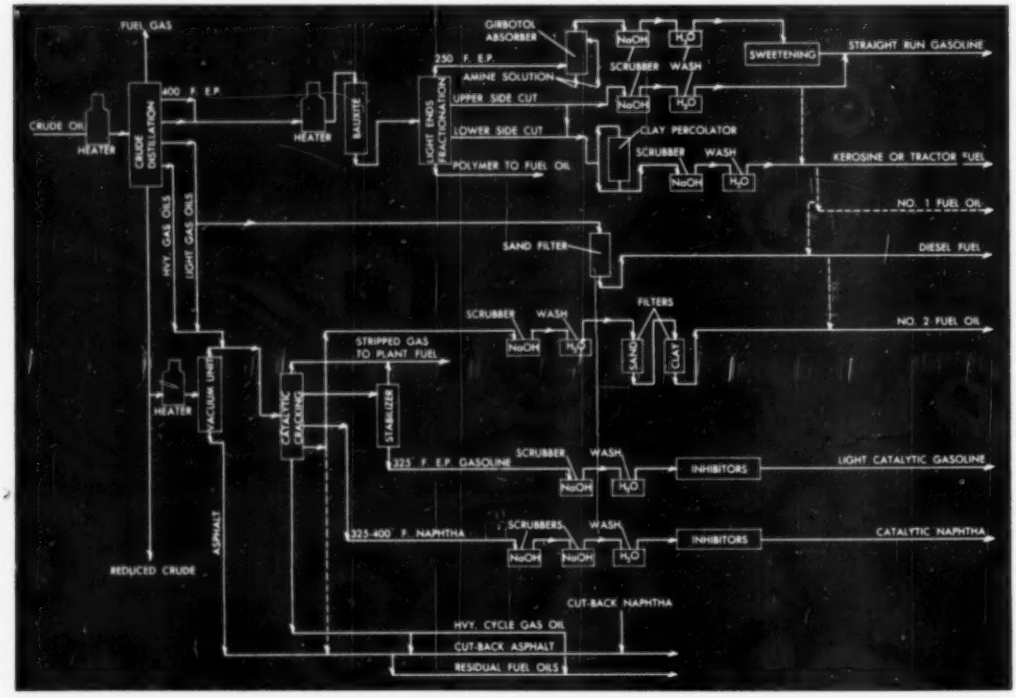
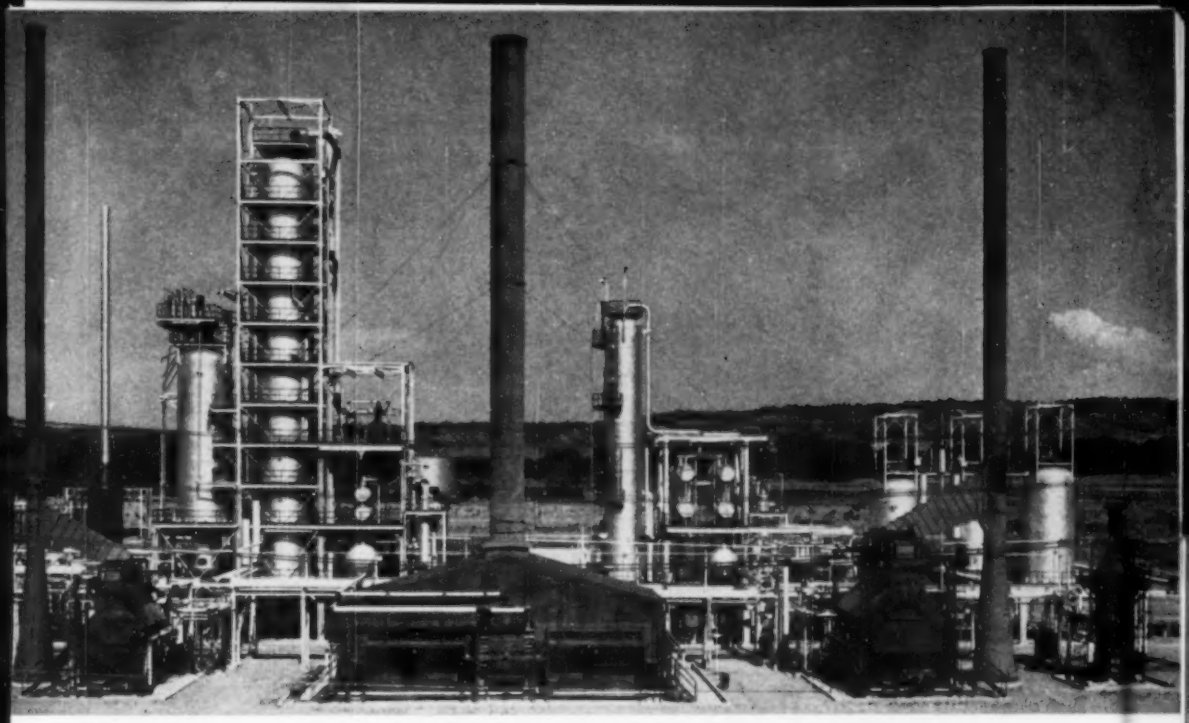


Fig. 1—Processing operations at Carter's Billings plant showing diversity of products possible



Overall view of crude distillation unit showing, left to right, vacuum still heater, vacuum unit, crude distillation column, crude heater, distillation fractionator and auxiliaries, bauxite desulfurizers and heater

Elk Basin (90%) and Frannie crudes (5%), along with some 5% of miscellaneous crudes. Of the latter, the predominant one is Oregon Basin crude used primarily for its high quality asphalt content, since the operation centers around production of high quality gasoline and light fuels, plus road oils and asphalts, with a relative minimum of heavy fuels. Overall design yields of products are given in Table 1.

Vacuum distillation for the production of heavy catalytic cracking stock was chosen because asphalt meeting requirements for the road and cutback types is an especially desired product, while the production of heavy fuel oil is relatively incidental. Fig. 1 is a schematic of plant operations.

Crude Distillation

The crude unit proper is divided into four sections; atmospheric and vacuum distillation, catalytic desulfurization and clay percolation. The primary distillation unit, an alloy-lined vessel 13 ft. by 100 ft. containing 31 bubble trays taking feed from a conventional Standard Oil Development Co. design heater, yields gas, gasoline, light and heavy gas oils and reduced crude. A 400-end point gasoline is taken overhead from the atmospheric tower, which operates at 3 to 4 psig. Also, by utilizing two pumparound reflux circuits three side-cuts are made, consisting of kerosine, Diesel fuel and virgin gas oil, with reduced crude as bottoms.

The gasoline and kerosine streams are combined for conventional catalytic desulfurization with regenerative bauxite. The two chambers are capable of handling approximately 9200 b/d each. These combined streams then are split into four cuts in the gasoline fractionating column, the 0 to 250° F. overhead being treated by a conventional Girbotol diethanolamine absorber for removal of hydrogen sulfide, then caustic scrubbed, water washed, and sweetened.

The 250 to 400° F. stream is separately caustic scrubbed and water washed before being stream blended with the 250° F. E.P. product. The lower side cut, largely kerosine and No. 1 fuel oil, is treated for color stability, caustic scrubbed and water washed.

The light gas oil stream from the crude distillation unit is caustic washed, water washed, and sand filtered, the quantity being augmented as desired from the lighter streams previously mentioned to meet specifications. The heavy gas oil stream commingles with the gas oil produced on the vacuum tower.

TABLE 1—Design Yields of Products

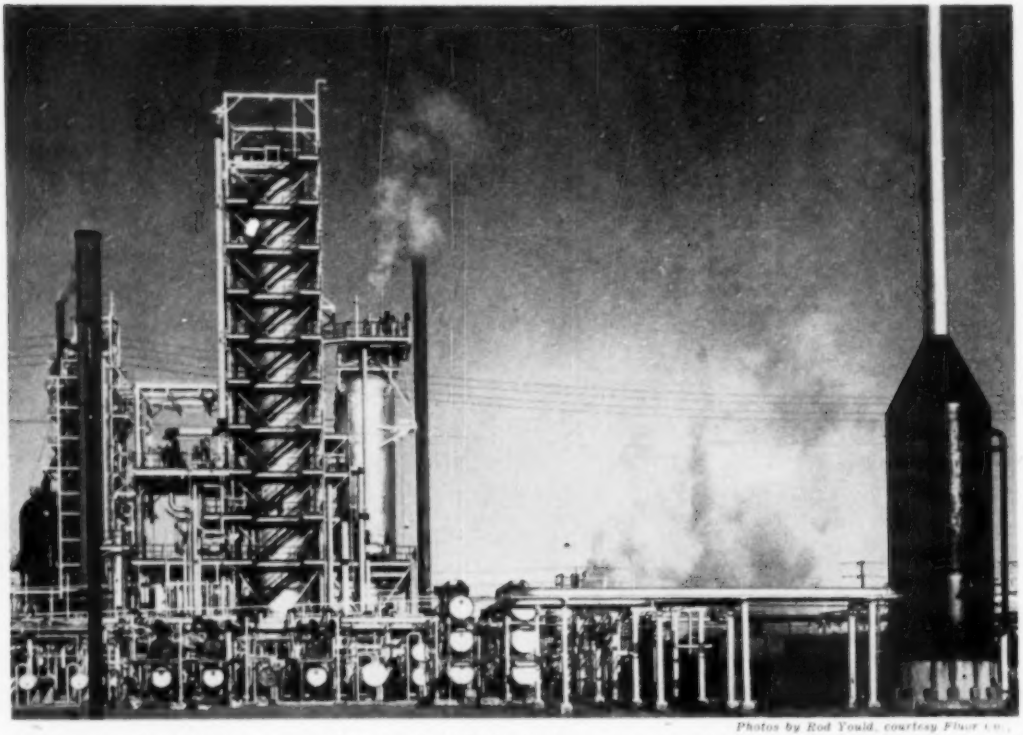
Product	Percent on Crude	Volume B/CD
Gasoline	43	8600
Kerosine, Diesel and Light Fuels	30	6000
Heavy Fuels	16	3200
Road Oil and Asphalt	6	1200
Refinery Gas	5	1000
Total		20,000

The vacuum tower, also alloy protected, operates at 30 mm Hg. absolute pressure, with charge from a standard U. O. P. heater and stripped with steam at the bottom. The column is 12 ft. 5 in. diameter by 48 ft. high and contains eight trays and two sets of discs and doughnuts. Total product is taken as a side stream, the overhead being largely condensed steam dropped to the sewer through an oil separator. A portion of the gas oil withdrawn is returned to the top tray as reflux.

A heavy gas oil pumparound circuit is used, entering slightly below the middle of the tower, to wash back any asphalt and slop waxes carried upward from the flash zone. A portion of this stream is diverted to remove accumulations of the slop wax fraction. The bottoms product, asphalt, is subsequently fluxed with naphtha, distillates, or cycle gas oils to produce cut back asphalt and may be combined with additional heavy cycle oil to make heavy fuel oil.

Fluid Catalytic Cracking

The 10,000 b/d Fluid catalytic cracking unit is unusual in several respects although in the main it follows the standard Universal Oil Products Co. design. The "upside down" relation of reactor and regenerator—i.e., regenerator below reactor—was chosen to produce a counterflow of catalyst and regeneration air and also to permit higher



Photos by Rod Yould, courtesy Fluor Co.

Close-up of crude distillation unit. Atmospheric distillation and vacuum towers at left, heat exchangers in foreground and blow down at extreme right. At extreme left may be seen a portion of the cracking unit

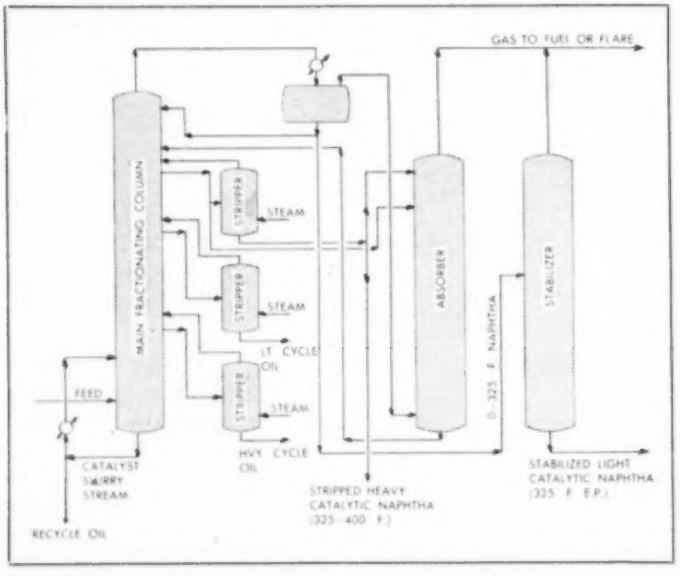


Fig. 2—Flow schematic of catalytic unit distillation and gas recovery system

regenerator pressure. This, in turn, permits a smaller regenerator and lowers catalyst losses.

In this particular unit, catalyst losses range from 1 to 1.5 tons per day, representing 0.22 to 0.3 lbs. of catalyst per daily barrel of charge, despite the fact that neither precipitator nor slurry thickener is installed. The regenerator is equipped with three sets of three-stage cyclone separators and has no waste heat boiler.

A ceramic monolithic type lining is used for insulation as well as erosion resistance in the regenerator and several large diameter pipe sections. The lining is of gunited construction, reinforced with hexagonal steel grid material. Temperature in the reactor is held at approximately 900° F.; 1100° F. in the regenerator. Regeneration air amounts to 23,000 S cfm. at 25 psig. when catalyst circulation is 12 tons per minute.

Another interesting sidelight on this unit is that the hydraulically actuated Chapman slide valves do not use the usual aviation hydraulic oil. Instead, ethylene glycol with suitable corrosion inhibitors has been substituted for its properties of non-

inflammability and relative freedom from extensive viscosity-temperature changes, the latter particularly important at Billings because of the rigorous winters.

Gas Recovery

The catalytic unit fractionator produces three principal streams as shown in Fig. 2: 0 to 325° F. naphtha overhead, a 325 to 400° F. naphtha, and two gas-oil streams. Part of the heavy gas oil is combined with the bottoms slurry stream as recycle to the reactor and the balance is heavy fuel or utilized in making cut back asphalt and road oils. The light cycle oil is used in No. 2 burner fuel. The 0 to 325° F. naphtha stream, combined with compressed gas, is flashed of vapors and charged to the stabilizer, leaving as light naphtha bottoms.

Gas from the crude unit, some 200 Mcfd., is compressed to 55 psi. and enters a drum where it is contacted with the light catalytic naphtha stream. Cracked vapors, amounting to 5500 Mcf. per day, also are compressed to 55 psi. and enter the same drum. Overhead vapors are fed to the absorber, while the liquid joins the main naphtha stream to the stabilizer.

The second naphtha stream, a side-cut, splits into two streams, the first being stripped and the second bypassing the stripper to enter the absorber as sponge-oil. Stripper overhead returns to the fractionator. Part of the stripped material serves as absorption oil and the balance is withdrawn as heavy naphtha. Absorber fat oil returns to the fractionator.

Stabilizer and absorber overhead gas, propane and lighter, is utilized as fuel gas or flared. A catalytic polymerization unit on this stream was called for in the original design but later was eliminated by steadily rising construction costs. The plant expects shortly to switch to a silico-magnesia catalyst, in order to reduce gas and light ends production.

Treating of the catalytic naphtha streams consists of a 2-stage caustic wash for the heavy cuts from catalytic cracking. A single stage wash is used on the light fraction.

Utilities

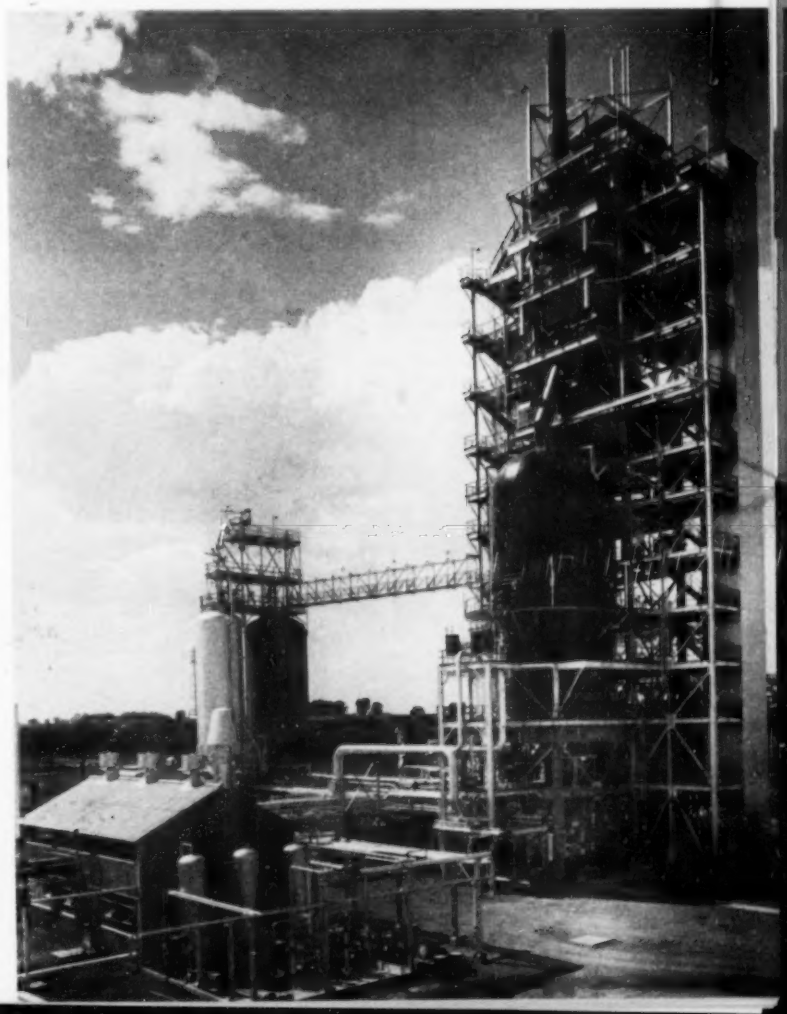
This newest Carter refinery does not have a cooling tower. Approximately 15,000 gpm. of water is taken by three electrically-driven deep-well pumps (one a stand-by) directly from the Yellowstone river to supply all plant requirements except drinking water. In addition, two gas-engine driven pumps have been installed to supply emergency water for fire-fighting.

In winter the river water has a temperature of about 31° F. and, when atmospheric temperature is 25° F. or colder, it is necessary to recycle a portion of the hot "used" cooling water to prevent formation of needle ice in the water lines. Effluents returned to the river pass through an API separator and meet all local and state anti-pollution requirements.

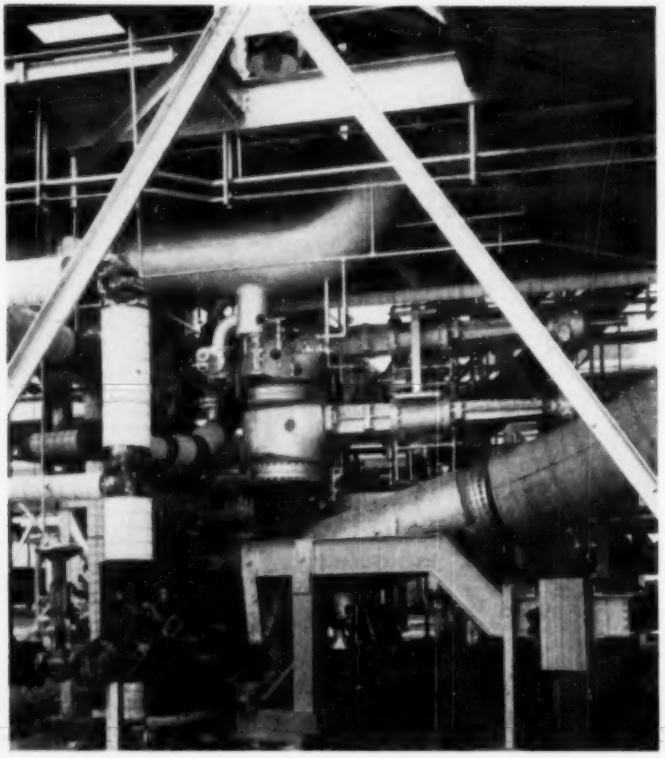
The refinery depends on purchased electric power. In case of a power failure a 30,000 bbl. tank and a 5000 gpm. turbine-driven pump are provided at the boiler house to supply emergency cooling water for approximately one hour. Boiler water is treated with hot lime-soda and two 5500-bbl. tanks store enough feedwater to meet requirements for nearly 23 hours.

For this reason also, every vital motor-driven pump in the refinery, with the exception of the cooling water pumps, is spared with steam turbines. In addition, pumps handling heavy products are steam-traced for winter operation. Because of the cold winters, all control instruments and meters (largely Brown, Foxboro, Leeds & Northrup and Taylor) located outside control rooms are housed in steam-heated boxes.

There are four Babcock & Wilcox boilers rated at 42,000 lbs. each of 415 psi. 625° F. steam. Only the firing aisle is within the boiler house, which also houses feedwater treating facilities. Boilers are fired either with refinery gas or fuel oil and entirely automatically (Republic) controlled. The output of two alone is required by the Ingersoll-Rand 3300 hp. steam turbine driving the main air blower for the cracking unit, which exhausts to the 90-lb. refinery steam system. This system serves turbine drives on other pumps and also is used for



Fluid catalytic cracking unit, with catalyst storage hoppers in background, left, turbo-blower building with hydraulic and air system equipment, and catalytic unit at right



Close-up view under regenerator showing reactor riser line, reactor "Y-piece" and two slide valves; note counterbalance support. Hydraulic liquid is corrosion inhibited ethylene glycol

two large pumping engines with auxiliary foam truck equipment for handling air foam. Water fog equipment is provided also. Portable Dugas extinguishers are located throughout the plant. All tanks with the exception of those handling asphalt are provided with a foam-blanketing system, the lines being painted yellow for quick identification. In addition, each tank has an individual dyke capable of containing the entire capacity in event of rupture or boil-over. A good network of modern macadam roads makes for quick access to any part of the plant. All process piping except sewer and water connections is on overhead racks.

The maintenance shops use approximately 100 men embracing the usual refinery crafts, and are located in a single area which also includes the plant warehouse. The most modern of machines are provided to permit equipment repair and maintenance, and emergency fabrication of many parts.

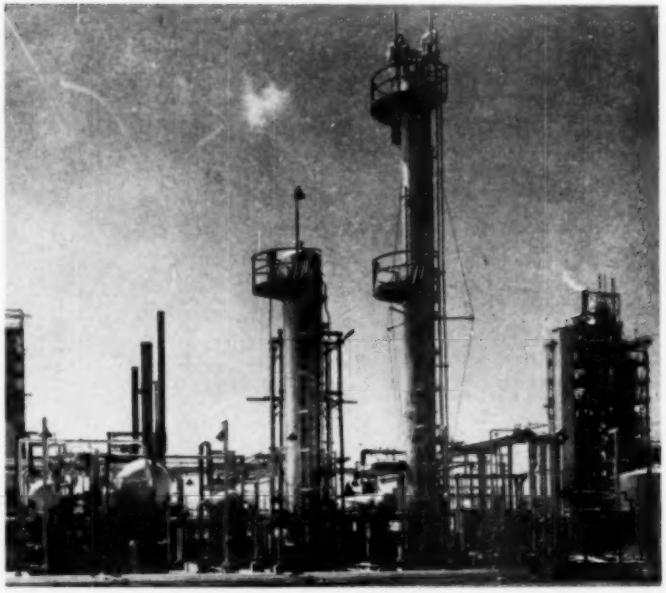
Principal vessels were supplied by A. O. Smith, Consolidated Steel Corp. and F. W. Glitsch & Sons Co.; oil storage tanks by Chicago Bridge & Iron Co.

process heating. Uncontaminated condensate is returned to the boilers while oily condensate is cleaned and discharged to the river.

The refinery has 64 oil and three water tanks, providing storage capacity for 1,410,000 bbls., divided into 182,500 bbls. for crude, 683,500 for intermediate storage of unfinished stocks, 500,500 for finished products and 43,500 for raw and treated water. A group of 12 comprises the asphalt and road oil blending and storage facilities, with eight additional tanks holding base stocks for manufacture of penetration asphalts and road oils. Adjacent is the asphalt truck-loading rack.

The tank car loading rack consists of two tracks having 16 loading spots each, with a loading platform directly between the two. The platform has push-button controls for remote operation of loading pumps. With these facilities it is possible to load a 10,000 gal. car with gasoline or fuel oil in 10 min.; asphalt cars in one hour, and as many as 80 cars per day. To one side and downhill from the loading racks, between them and the main product storage area, are the lead-blending facilities.

The plant is completely equipped with fire fighting facilities. There are



Close-up view of gasoline treating facilities

Increase Width of Inlet Chamber In New Waste Water Separator

By J. S. BAUM, Light Oil Department Foreman
Cities Service Oil Co., East Chicago

IN THE design of the two-stage oil waste water separator installed at Cities Service Oil Co.'s East Chicago refinery as part of its $20,000,000 modernization program, the inlet chamber width was increased to give approximately five minutes detention time for waste in it. In actual practice about 95% of the oil and 85% of the sludge are removed in the inlet chamber.

The separator, designed for a maximum flow of 9000 GPM, is in accordance with API recommendations except for the 10-ft. width of the inlet chamber. Below is a photograph of the separator when completed. There are a total of four 20-ft. wide parallel separators, with the primary chambers 47 ft. in total length, the secondary chambers 64½ ft. The inlet chamber extending across the four parallel separators is divided into two sections, each section being 10 ft. in width and 40 ft. long. Flight skimmers and scrapers were installed in each of the two inlet chambers and the four primary chambers. Flight skimmers and scrapers were omitted in the secondary chambers but provisions were made for their installation at a later date if required.

The inlet chambers were enlarged and equipped with flight skimmers and scrapers for the purpose of removing the major portion of the oil and sludge before the water entered the primary chambers of the separator. This has greatly simplified the operation of the separator, particularly in the cases of sludge removal, as there are only four sludge valves, two in each inlet chamber, requiring operation for sludge removal. Aside from requiring less work on the part of the operators in keeping the oil and sludge removed, it also saves wear on the flight scrapers located in the primary chambers, since these operate only 25% as much as those in the inlet chamber.

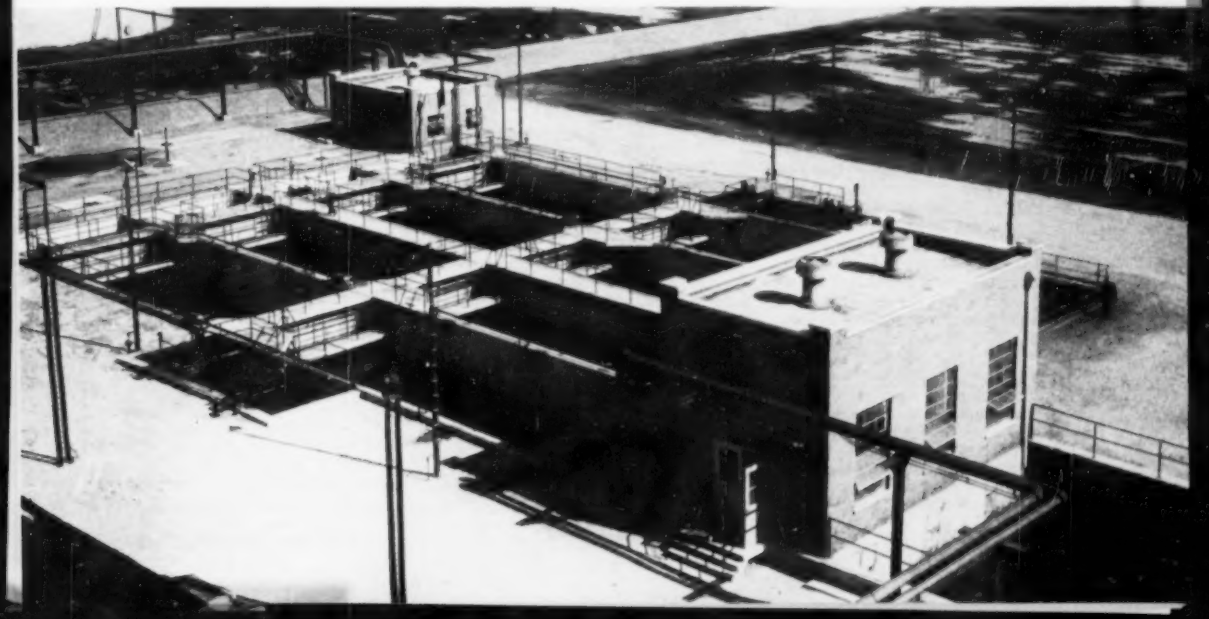
The sludge in the two inlet chambers and the four primary chambers is removed with an 8 x 9 x 18 in. duplex, block valve, piston pattern reciprocating pump. The pump is located below ground level to insure that the pump operates with a flooded suction at all times. This type pump has performed very satisfactorily in this service.

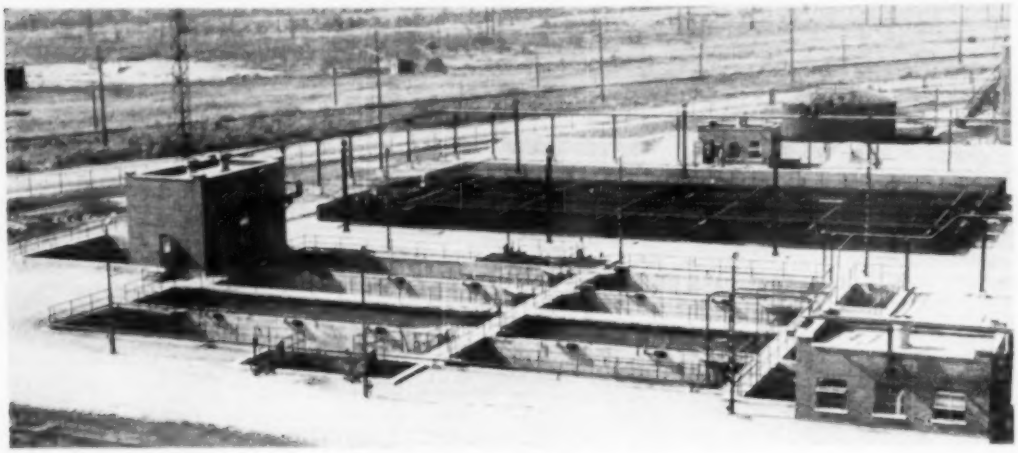
The oil removal pumps, located above the oil pits on each side of the separator, are float controlled, electric driven, vertical, deepwell, open shaft, turbine type pumps. Considerable difficulty has been experienced with these pumps due to bearing failure resulting from abrasive material present in the skimmed oil. Also, screen plugging has been a major problem due to presence of fibrous material in the oil collecting on the pump screens. Since these pumps have proven unsatisfactory for this type service, it is planned to replace them with a sewage type, single-stage, vertical pump with a two-port, non-clogging impeller, in a volute case.

The vertical shaft is totally enclosed and the bearing sealed so the pumpings do not come in contact with the shaft or bearings. The pump is designed to operate without a screen and is capable of handling entrained solids up to 2-in. in diameter.

Due to the low elevation of the plant, it was necessary to pump the effluent of the separator. Any disruption of flow through the separator would be serious due to the hazards involved should the sewer system back up into unit areas. For this reason particular attention was given to the type and number of pumps to be installed in this service. The type selected for this service was a vertical deepwell, one-stage, even-

General view of the new 9000 GPM oil-water separator recently completed at the East Chicago refinery of Cities Service Oil Co.





Another view of the new oil-water separator, with the plant's clear water separator in the background

flow propeller type pump. Three pumps were installed, two of which are spares for the regular pump. The pumps are arranged to cut-in automatically as the water level rises in the effluent chamber. The pump installation also includes an alarm system.

The effluent water is lifted approximately 9 ft. into a mixing chamber where it joins with the plant cooling water and flows by gravity ⅝ of a mile to the Grand Calumet River.

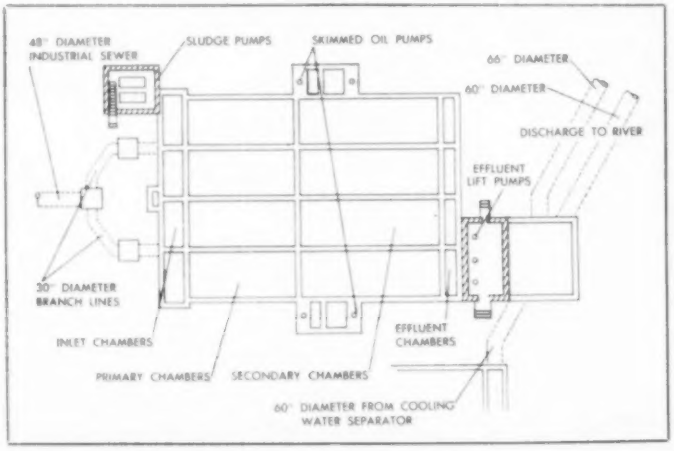
A laboratory survey of the plant waste waters was made prior to the design of the separator. The study revealed that the boiler house wastes and wastes from the pressure still blowdown sump were major contributors to poor separation of oil in the waste waters. The wastes from these two units joined in a common sewer before entering the separator. At the point of intersection globules of oil were formed which contained coke dust, boiler treating wastes and oil. Many of these globules of oil emulsions were of the same density as water and consequently could never be separated in a gravity type oil separator.

The boiler house wastes were removed from the waste water sewers and handled as a separate waste disposal problem. The pressure still blowdown sump was eliminated at the time of retiring the old thermal batch coke stills, which were replaced with a delayed coking unit and Fluid catalytic cracking unit in the plant modernization program.

The handling of wastes from the new delayed coking unit was included in the design and thus was never allowed to enter the waste water sewer system. The principal waste disposal problem at the coking unit is the waste water from the hydraulic method of removing coke from the coke chambers. The unit has a recirculating water system and the water from the coke chambers is pumped to a Dorr Thickener to remove the coke fines before being recirculated.

The new API separator has met all expectations with regard to ease of operation. The oil removal pumps and the effluent water pumps being automatically controlled require very little attention. The operation of the flight scrapers and removing the sludge is manual and constitutes the major portion of work required to keep the separator operating, yet this requires an average of only two hours per day.

The skimming of oil in the inlet chambers is continuous due to the large quantity of oil removed here. The skimming of oil in the primary and secondary chambers is done intermittently depending on the quantity of oil present. The refinery uses once-through water operation, pumping the water direct from Lake Michigan. The cooling water from the plant flows through a separator parallel to the new API separator. The effluent of both seperators joins and flows to the Grand Calumet river, which empties into Lake Michigan some eight miles distant from the plant. The total effluent waters have been approved by both city and state health departments, who are very much interested in pollution in the surrounding area.



Layout of the recently completed Cities Service separator

Strategy for True Liberals

By ROBERT E. WILSON, Chairman, Standard Oil Co. (Indiana)

Dr. Wilson in times past has addressed petroleum refiners on various scientific and economic problems, through his capacity as a recognized leader of that industry. This message from him, in a wider field, is the most important he ever brought to the men engaged in the petroleum refining industry, who face with all other Americans the coming decision whether our way of life shall be that of individual initiative and freedom, or state socialism. Dr. Wilson's contacts over many years with government, labor and industry leaders qualify him amply to speak on this subject.

This address was delivered before the Freedom Dinner sponsored by the Transportation Assn. of America in Chicago, Nov. 30, 1949.

IT IS INSPIRING to have Agriculture, Finance, Transportation and Industry finding firm common ground in the need for preserving our freedom at all costs. Indeed, it is a program on which all thinking Americans can unite, once they really understand the issues.

It is high time we united, because separate attacks on that freedom have made frightening progress, especially in the field of transportation. While our attention has been diverted by the noisy attacks of traitorous Communists, usually operating behind a front, the Socialists and the demagogues have been nibbling away steadily at our freedoms, often almost unnoticed. While many of them were hand in glove with the Communists only a few years ago, and still welcome Communist support on many matters, today they try to throw us off our guard by outdoing us in berating the Reds.

Revolution by Nibbling

Make no mistake—revolution by violence is *not* our real danger. What might be called "revolution by nibbling" is already far along. The power of the Communists is dwindling as their masks are torn off—but that of Socialistically inclined bureaucrats is steadily increasing. Every time they add to the government payrolls or subsidy lists they gain recruits and votes. Before it is too late we must stop the fatal process of buying the people's votes with their own money. One man in seven is today, directly or indirectly, receiving money from the government—which means, of course, from the rest of us.

To get a picture of the strategy we must meet, let's look at one of the most recent left-wing textbooks —"Strategy for Liberals" by Irwin Ross. If you want a home hair-curl, read it some evening! His panacea is what he calls the "Mixed Economy"—provided, of course, his group can determine the proportions of the mixture. To disarm opponents he says in his introduction:

> "Two decades ago numberless people who now flock to the mixed economy would have embraced Socialism. With the government owning virtually all business and industry, the economy would be planned from top to bottom. . . .
>
> "Today the bloom is off complete, topside, all-out planning. The current disillusion has many causes, of which the most important has been the Russian experience. We have learned from the Soviets that where the government runs everything, no man is free. . . .
>
> "We have learned that any planning inevitably involves bureaucratic problems. For every new area of decision brought under government control the number of planners seems to increase by geometric progression. Our war experiences provided abundant evidence of the red tape, the layers of deferred decision, the human inefficiency involved in the functioning of a huge bureaucratic apparatus. Bureaucracy becomes a restraint on freedom."

With such a fine introductory analysis one might expect the writer to proceed to some sound recommendations. But no—he's a nibbler or worse. He defines his mixed economy as (and I quote) "a blend of capitalist, socialist and cooperative elements—with the government supervising and coordinating the whole mechanism *through the exercise of its spending and taxing powers.*"

That last expression is more than vaguely reminiscent of the old formula—spend and spend—tax and tax—elect and elect! In other words, after clearly pointing out that the road to a planned economy is the road to disaster, he urges us to hurry down that road until we reach a point where we cannot turn back. He advocates building a zealous missionary group of 80,000 to 100,000 to spread propaganda, achieve control of labor, farm and other mass organizations, and eventually the Democratic party, which he says is now "too slender a reed to lean on." Exactly how far he would now take us is not wholly clear, even after reading the entire book; but that it is much *too* far is abundantly clear from two sentences:

> "We are heading in the same direction as the British, but they have advanced much farther along the road. *It is important that we catch up!*"

Can you imagine that, in view of the deplorable state of the British economy today? And if we ever do catch up, who is going to help the British? Or, more important, who is going to help us? You know the answer—no one.

Name-Calling Tactics

But to revert to the textbook—and other textbooks—how is this gradual socialization to be put over? Well, its a familiar campaign. Call all big business monopolistic. Where you can't sell that moss-covered idea (since "mono" means "one" and there is nothing even resembling a monopoly in any major industry today), create a new specter called "oligopoly," or control by the few, and define that word "few" to mean whatever number of major competitors there happens to be in any given industry. It doesn't matter how strenuous the competition is within the industry, or between it and other industries, it can still be called an oligopoly—and that's an ugly word!

Other regular tactics of the nibblers are to attack the motives of business and its leaders. Communists, Socialists, some labor leaders and many politicians all join in chanting the theme—everyone who opposes them is simply power-mad and greedy—their own motives are always pure. To mention some favorite targets:

Attack bigness—try to convince small business that their primary interest is opposed to that of the larger concerns.

Attack big business if prices rise,

and attack them again if they cut prices.

Attack the doctors or the insurance men if they show signs of resisting moves to regiment them.

But never, never attack the real monopolists of today—the bosses of Big Labor whose insistence on industry-wide bargaining is the most serious threat to small business today.

Tax and Tax—Spend and Spend

And remember those ominous words—"through the exercise of its (the government's) spending and taxing powers"—to which Ross later adds "the power to loan and to subsidize"!

Tax industry and its owners so heavily that it can't keep up with demand—and then use some of the tax money to build up competition, either under government ownership or by loaning huge sums to men who happen to be in the good graces of the ruling party. Give the cooperatives a tremendous tax advantage so they can expand much faster than private industry. Steadily narrow the tax base by this expansion of the relatively untaxed enterprises owned by cooperatives, institutions or the government, until private industry's tax burden is so heavy that its greater efficiency becomes less conspicuous. Use our tax money and our dwindling supply of equity capital to build up competitive industries in socialistic countries abroad. Since Mexico seized American oil properties and then let the industry go to pot, loan them American tax money lest government ownership get the black eye it deserves. Finally, with industry so fettered that it cannot expand to take care of the growing labor force, unemployment is bound to rise and depression will make possible the final take-over of industry.

Yes, gentlemen, that's the strategy—but not the strategy of *true* liberals. I'm not ready to hand that fine word over to the Socialists or the nibblers, for "liberal" comes from "liber" meaning "free," and *theirs is not the way to freedom.* The man who fights for freedom, wherever and however it is threatened, is, and always has been, the *true* liberal.

How far has this nibbling program progressed in industry? That differs in different industries, but it is dangerously far along.

The tax burden is already crushing, and even more is threatened.

Incentives for people to work hard, to produce more, to save for old age or for their children have all been dangerously weakened.

The shortage of equity capital is serious in many industries.

More and more industries are hampered by unnecessary regulations, such as those which have ham-strung our railroads over the past forty years.

There is more and more government competition, especially in the field of power.

The areas in which management can act to protect or promote its business are being narrowed every year. It is surprising to a new executive, after hearing so much about the "unbridled power of industrial leaders," to find how little they actually have.

One law—which intelligent industry welcomes as a necessary part of American competitive enterprise—bars agreements in restraint of competition. But now we're getting more and more laws and commission orders that sharply limit the ways in which we can compete. The idea seems to be that we must compete, but that no one must be hurt or lose any business in the process! The consumer cannot be properly protected by such soft competition.

What Can We Do About It?

The final and important question is—what can we do about it? What should be the strategy for *true* liberals? I should like to suggest twelve answers, the first seven of which will involve our discontinuing some of the things that many of us industrialists have been doing:

1. We must stop running to the government for help. Many of the agencies we complain about—RFC, NRA, FCC, FPC, etc., etc.—were started at the request of business men, frequently with some simple worth-while objectives. But watch them grow—proliferate—add functions—spend and spend. Every control calls for a dozen more to make the first one effective—and so it goes, ad infinitum.

Business men in the Commerce secretaryship, such as Hoover and Harriman, have frequently expressed their surprise at how many apparently ardent free-enterprisers come to Washington to ask government help for this or that. Today such activity is more understandable, if not more forgiveable, because the only sort of enterprise that finds it easy to get new capital is one which has learned how to tap the right sources in Washington.

2. We must stop running to Washington to complain about our competitors or to urge the government to regulate a competing industry. Many other agencies and activities about which we complain got their start from just such complaints. While there may be some equity in demanding the regulation of a competing industry just because we are regulated, progress toward freedom doesn't come that way. Far better to follow tonight's program and enlist the other industry's support in helping us to strike off our shackles before we are all shackled.

3. We must get it out of our heads that the common man is going to get worried about our problems or our freedom unless he understands how it affects him. Demagogues have sold too many of labor and the public the idea that the less freedom business has, the better for him. *We* know this is not true, but we must demonstrate the fact that the freedom and prosperity of private business mean more and better tools, higher productivity, greater real wages and far more security for the common man.

4. We business men must stop talking to ourselves and speak before audiences which are less glamorous and friendly, but more numerous and politically potent. No converts are being made in this room tonight. This meeting will be a failure if its influence doesn't spread far and wide and get down to the grass roots.

The white-collar groups must be made to realize that their future is seriously imperilled. Millions of people now apathetically view the socialist trend as something that will affect only "the rich." Actually, socialization hits the white-collar people first, and hard. We must bring home to them what has happened to those who were once the great middle class in Britain.

5. In my opinion **we shouldn't try to talk about broad generalities like free enterprise or statism,** but rather tell the accomplishments, problems and aspirations of our own business—our own industry—or the role of industry in our own community. Make clear who really owns your company and how little the investors, whose savings furnish the tools, receive in comparison with the men who use them.

The worst fault of business is that it has not made itself understood. A survey made three or four years ago indicated that 72% of the public thought that industry's profits totaled *more* than industry's wages! (Actually profits even in 1948 were only one-sixth of wages.) A more recent survey showed that more than half of the public believed that *most* of industry's profits went to the bankers and Wall Street operators! Well, if you believed those two canards, both so far from the truth, wouldn't *you* think that profits were too big and that industry needed to be more closely regulated?

Let's be thankful that we don't face the difficult problem of changing the opinions of people who know the facts. Ours is the simpler one of getting the facts across to the people—counteracting the lies that so many groups have been feeding them about business and industry.

6. We must stop being defeatists and go to work. One characteristic of the American business man has been that he "never knows when he

is licked"—but all too many talk as if the present outlook were hopeless. If *we* give up, it *is* hopeless.

7. We must stop depreciating our verbal currency by calling everything we don't like Socialistic or Communistic. And we mustn't condemn everything the opposing party does. The overdue reaction against "me-too-ism" mustn't lead us to the opposite extreme. We can't even condemn all bureaucrats. Many of them are conscientious, hard-working public servants.

8. We must make sure that our own house is in order and that we maintain high ethical standards throughout the business community. Justly or not, the opposition will charge *all* of us with the sins of even a small minority.

We must remember that the first principle of good public relations is to do what is right in the public interest. Also, we in big business must realize the importance of having small business prosper and grow if they are serving the public well.

9. We must appreciate the necessity for the economic education of our own employees. We must make them realize their progress and security are mainly dependent on ours and not on the government. And we must make sure that that is the fact.

10. We must clear up misunderstanding as to who is paying for all these activities at home and abroad. I am informed that the total confiscation of all incomes above $8,000 would only pay 10% of the total federal, state and local tax bill. We must make people realize that 90% of this load is on the common people, though much of it is well concealed.

11. We must all realize an attack on the freedom of one is an attack on the freedom of all, and stand together. Doctors—lawyers—dentists—engineers—insurance men—and countless others are all potential allies if we understand our common desires and dangers and help one another in the fight.

12. Finally, when we get discouraged let us remember that early death of our democracy was widely predicted 160 years ago—and for the very reasons that now threaten us—the belief that if the common man had the vote, demagogues would be able to sell them false nostrums which would eventually destroy the republic. Yet our republic has survived and we've made unbelievable progress.

As George Washington said to some of the pessimists over 150 years ago:

"The mass of citizens of the United States mean well and I firmly believe *will always act well when they can obtain a right understanding of matters.*" Our number one job today is to give them that right understanding.

Details on Platforming Process Scheduled for WPRA Meeting

DESIGN details and operating results on commercial Platforming will be disclosed for the first time at the 28th annual meeting of the Western Petroleum Refiners Assn., to be held in San Antonio, Mar. 27, 28 and 29. The information will be given in the form of a paper, scheduled to be presented by Dr. Vladmir Haensel of Universal Oil Products Co.

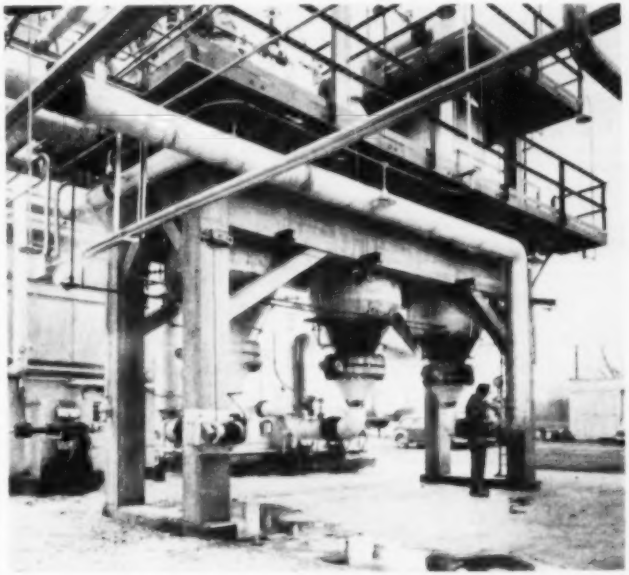
Platforming is a catalytic reforming process for upgrading straight run gasoline. It was developed by Dr. Haensel and other U. O. P. engineers, and was first disclosed at the 1949 annual WPRA meeting. Since then one commercial unit has been built—at the plant of Old Dutch Refining Co. in Muskegon, Mich., where it has been operating continuously since going on stream last Oct. 28.

The opening technical session of this year's annual WPRA meeting will be held Monday afternoon, Mar. 27, and includes two papers. The first, by Albert J. McIntosh of Socony-Vacuum Oil Co., will discuss present stocks and future demand for various types of petroleum products. The second, by Bruce O. Buckland of General Electric Corp., will describe the performance under road conditions of the new GE gas turbine engine for railroad locomotives, designed to burn a heavy residual-type fuel oil.

Dr. Haensel's paper on Platforming is scheduled for the second technical session, Tuesday morning, Mar. 28, which will also include a talk on "Boiler Water Treating" by R. C. Ulmer of Power Chemicals Division, E. F. Drew & Co. He will discuss problems involved in water treatment—scale, corrosion, algae.

The final technical session, Wednesday morning, Mar. 29, will include discussions on the future trends in automotive engine design, by John M. Campbell, of the Research Laboratories Division, General Motors Corp., and on "Progress and Trends in Petroleum Refinery Instrumentation," by Douglas M. Considine, of Brown Instruments Division, Minneapolis-Honeywell Co.

THIS MONTH'S COVER PICTURE



Shown above is the reactor section of the first commercial Platforming unit, installed at the plant of Old Dutch Refining Co. at Muskegon, Mich. Details on the design and operation of this unit will be revealed for the first time at the annual meeting this month of the Western Petroleum Refiners Assn. at San Antonio, Mar. 27, 28 and 29

Ethylene Production by Cracking Of Propane-Ethane Mixtures

By C. K. BUELL and L. J. WEBER
Phillips Petroleum Co., Bartlesville, Okla.

Part 1—Furnace Design, Operation

Ethylene is being manufactured commercially by thermally cracking propane-ethane mixtures in a tube still at between 1400°-1500° F. and at near atmospheric pressure, and at reaction coil contact times somewhat under 2 seconds. When charging a stock comprised of about 70 mol.% propane, 20% ethane and 10% methane, single pass yields of ethylene of about 30 lbs./100 lbs. of feed are obtained.

Factors entering into the mechanical design of high temperature gas cracking furnaces are discussed. Plant operating data are given showing the effect of reaction temperature, or depth of cracking, on the composition of the cracked gases and operability of the cracking furnaces and auxiliary equipment.

Part 2, discussing the selection of alloy steel for the cracking coil tubes and the inspection of tubes, will appear in the April issue of *Petroleum Processing*. This paper was presented at Conferences on Petroleum Refining of the Seventy-fifth Anniversary of the Colorado School of Mines, Golden, Colo., Sept. 30 - Oct. 1, 1949.

THIS paper is occasioned by the current interest on the part of the petroleum and petrochemical industries in the production of ethylene. Because of its reactivity, ethylene is coming into ever increasing demand as a raw material for the manufacture of an extremely wide variety of synthetic petroleum-derived chemical products, fuels and lubricants.

Included among the commercial ethylene derivatives, and some of their intermediate or end uses, are the organic chemicals listed in Table 1. This list is by no means complete; however, the chemical products shown illustrate the versatility of ethylene as a raw material and the many fields represented by its derivatives.

A recent survey of available statistics on ethylene consumption indicates the demand for ethylene is large and will continue to expand at an appreciable rate in the immediate future. According to a recent estimate prepared by associates of the authors, the 1948 production of ethylene in the U.S. from petroleum and natural gas sources was 755,000,000 lbs.* This compares with a production of only 166,000,000 lbs. in 1943, based on U.S. Tariff Commission data.

* Exclusive of ethylene used in ethyl alcohol synthesis. In 1948 synthetic ethanol is estimated to have consumed an additional 425,000,000 lbs. of petroleum ethylene.

One process for the manufacture of ethylene has been in successful commercial operation the past several years at a Phillips Petroleum Co. plant at Borger, Texas. In this process a propane-rich stream, containing relatively large percentages of ethane, is cracked thermally in a tube still to produce ethylene at temperatures between 1400° F. to 1500° F. and at a pressure near atmospheric. The ethylene is recovered and purified and used in the manufacture of aviation gasoline. However, the thermal cracking unit is equally adaptable to the production of ethylene for use in other processes.

Chemistry of Propane-Ethane Cracking

When propane-ethane mixtures are cracked at low pressures, high temperatures, and relatively short contact times, the major products resulting are hydrogen, methane, ethylene and propylene in accordance with the following cracking mechanisms:

$$\underset{\text{(Ethane)}}{C_2H_6} \rightarrow \underset{\text{(Hydrogen)}}{H_2} + \underset{\text{(Ethylene)}}{C_2H_4} \qquad (1)$$

$$\underset{\text{(Propane)}}{C_3H_8} \rightarrow \underset{\text{(Methane)}}{CH_4} + \underset{\text{(Ethylene)}}{C_2H_4} \qquad (2)$$

$$\underset{\text{(Propane)}}{C_3H_8} \rightarrow \underset{\text{(Hydrogen)}}{H_2} + \underset{\text{(Propylene)}}{C_3H_6} \qquad (3)$$

The relationship between the percentage of propane, or ethane, cracked, x, and the time of reaction in seconds, t, at a given fixed tem-

TABLE 1—Commercial Ethylene Derivatives

Derivatives	Intermediate or End Uses
Acetaldehyde	Chemical intermediate
Acetic Acid	Weak acid used in many industries
Acetic Anhydride	Chemical intermediate
Butadiene	Synthetic rubber; chemical intermediate
Cellulose Acetate	Artificial silk; transparent sheeting and other plastics; protective coatings; non-flame film
Di- and Tri- Ethanolamines	Wetting agents; rubber accelerators; absorbents for acidic gases
Dichlor Ethyl Ether	Solvent
2,3-Dimethylbutane (Diisopropyl)	Aviation fuels
2,2-Dimethylbutane (Neohexane)	Aviation fuels
Ethanolamine	Emulsifying agent; base for toilet creams; fruit sprays
Ethyl Acetate	Solvent
Ethyl Alcohol	Solvent; antifreeze; fuel; preservative; chemical intermediate
Ethyl Benzene	Chemical intermediate
Ethyl Cellulose	Resins
Ethyl Chloride	Refrigerant; anaesthetic; dyestuff; chemical intermediate
Ethylene Chlorohydrin	Chemical intermediate
Ethylene Cyanohydrin	Chemical intermediate
Ethylene Dibromide	Antiknock fluid additive
Ethylene Dichloride	Solvent; antiknock fluid additive; chemical intermediate
Ethylene Glycol	Antifreeze; chemical intermediate
Ethylene Oxide	Insecticide; disinfectant; chemical intermediate
Glycol Ethers	Solvents
Glycol Dinitrate	Safe explosives
Glycol Phthalate	Plasticizer
Glycol Stearate	Wetting agent; plasticizer
Ketene	Chemical intermediate
Lead Tetraethyl	Antiknock agent
Metaldehyde	Insecticide; solid fuel
Paraldehyde	Dyestuff; medicinals
Polyethylene	Plastics; synthetic lubricating oil
Styrene	Synthetic rubber; plastics
Triethylene Glycol	Germicide; plasticizer
Vinyl Acetate	Various plastics
Vinyl Ethers	Various plastics

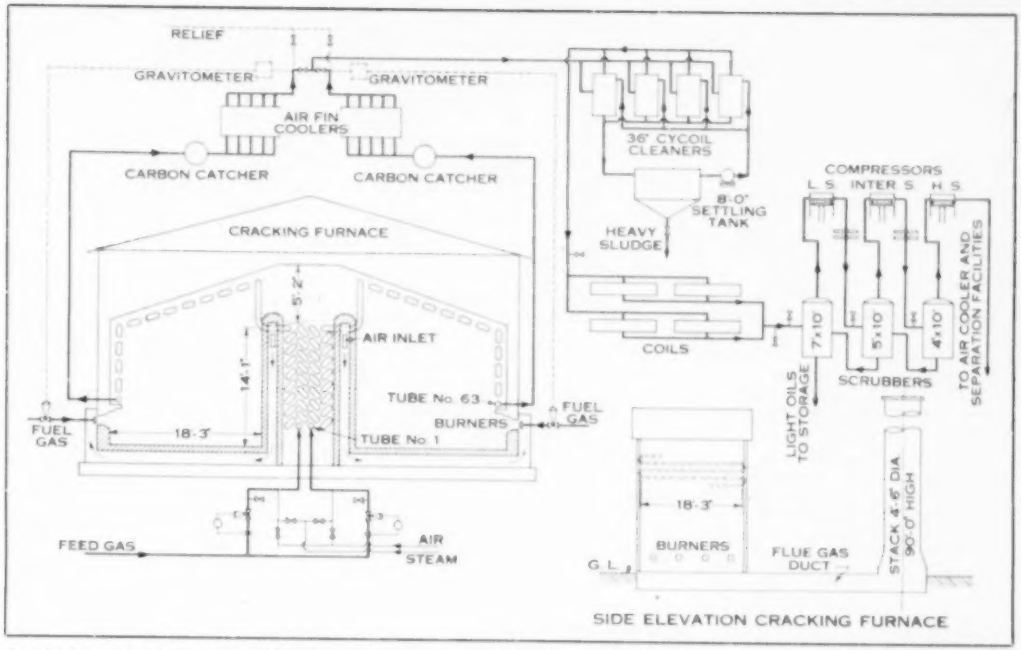


Fig. 1—Furnace arrangement and flow diagram for ethylene production by thermal cracking of propane-ethane mixtures

perature is expressed by the following equation:

$$k_1 = \frac{1}{t} \ln \left(\frac{100}{100 - x} \right) \quad (4)$$

where:

k_1 = cracking velocity constant (seconds)$^{-1}$.
t = time (seconds).
x = lbs. propane, or ethane, destroyed per 100 lbs. of propane, or ethane, in feed.

The value of the cracking velocity, or reaction rate, constant varies with temperature and is different for propane and ethane.

For propane, the variation of k_1 with temperature is expressed by the following equation:**

$$\log_{10} k_1 = 13.11 - \frac{24,650}{460 + {}^\circ\text{F.}} \quad (5)$$

Equation 5 is applicable over the unusually broad temperature range of 1020 to 2000° F.

** From unpublished data, Phillips Petroleum Co. Research Dept.

TABLE 2—Cracking Velocity Constants for Propane and Ethane

Temp. °F.	Cracking Velocity Constant (k_1) Propane	Ethane
1300	0.13	...
1350	0.21	...
1400	0.32	0.19
1450	1.60	0.46
1500	3.41	1.07

The following equation** expresses the relationship between the cracking temperature and the cracking velocity constant for ethane:

$$\log_{10} k_1 = 14.02 - \frac{27,423}{460 + {}^\circ\text{F.}} \quad (6)$$

Equation 6 is applicable over a temperature range of from about 1400 to at least 2000° F.

Values of cracking velocity constants for propane and ethane at several different temperatures are given in Table 2. Reference to this table will show that appreciably higher temperatures are required to crack ethane than propane.

The primary decomposition of propane and ethane is followed by secondary reactions involving not only the decomposition of the primary reaction products, but also the thermal polymerization of the olefinic products. The latter olefins polymerize to yield cyclic olefins, which in turn dehydrogenate to aromatics, which further condense and dehydrogenate under progressively more severe conditions yielding such degraded products as tars and coke. The thermal polymerization reactions are affected by time, temperature and pressure, as are the primary cracking reactions.

The primary pyrolysis reactions are endothermic and relatively rapid, whereas the secondary polymerization and condensation reactions are moderately exothermic and relatively slow. Under the conditions of operation used in the propane-ethane cracking process, the extent of such secondary reactions as discussed above is not very great. However, it is very important that the cracking reaction be conducted under conditions of as short residence time and as low pressure as possible since

TABLE 3—Cracking Furnace Feed Volume and Composition

(Feed to one-half of one furnace)

Component	Pounds	Wt. %	Mols.	Mol. %	Cu. Ft. (14.7 psia and 60° F.)
H_2	83	0.08	42	1.17	15,918
CH_4	12,333	11.53	771	21.53	292,209
C_2H_6	5,052	4.72	180	5.03	68,220
C_3H_8	52,109	48.63	1,737	48.50	658,523
C_4H_{10}	3,250	3.04	77	2.15	29,183
C_4H_8	33,600	31.40	763	21.31	289,177
C_5	637	0.60	11	0.31	4,169
Total per day	107,055	100.00	3,581	100.00	1,357,196
Total per hour	4,461				56,550

Average molecular weight: 29.9
Specific gravity: 14.7 psia and 60° F.: 1.032 (air = 1.000)

TABLE 4—Cracking Furnace Effluent Gas Volume and Composition

(Effluent from one-half of one furnace)

Component	Pounds	Wt. %	Mols.	Mol. %	Cu. Ft. (14.7 psia and 60° F.)
H_2	2,619	2.45	1,308	24.18	495,732
CH_4	25,906	24.28	1,625	30.04	615,875
C_2H_2	531	0.50	20	0.37	7,580
C_2H_4	38,385	35.84	1,370	25.32	519,230
C_2H_6	21,181	19.78	706	13.05	267,574
C_4H_6	8,747	8.17	208	3.84	78,832
C_4H_8	4,454	4.16	101	1.87	38,279
C_4H_{10}	1,430	1.34	25	0.46	9,475
C_5H_{10}	697	0.64	12	0.22	4,548
C_{7+}	3,045	2.84	35	0.65	13,265
Total per day	107,055	100.00	5,410	100.00	2,050,390
Total per hour	4,461				85,433

Average molecular weight 19.78

Specific gravity, 14.7 psia and 60° F. = 0.682 (air = 1.000)

TABLE 5—Designed Heat Distribution in One-Half of One Cracking Furnace

	Btu./Hr.	% of Total
Absorbed in radiant section		
a. Reaction heat	3,080,000	19.06
b. Sensible heat	1,000,000	6.19
Absorbed in convection section	4,000,000	24.75
Radiation loss from radiant section	485,000	3.00
Radiation loss from convection section	323,000	2.00
Lost in stack gases	7,275,000	45.00
	16,163,000	100.00

the greater the time and pressure, the greater will be the extent of thermal polymerization. Not only should the secondary reactions be suppressed to prevent consumption of ethylene through the formation of heavy oils, tars and coke, but also the production of these undesirable by-products imposes operating difficulties as will be discussed later in this paper.

Cracking Furnace Design

As indicated above, the mechanical design of a gas cracking furnace for the service discussed in this paper must accomplish the objectives of preheating the gaseous feed stream to cracking temperature and then quickly furnishing the heat necessary to obtain the desired degree of cracking. The design must also be such that the heat of reaction is added to the gas at as low pressure as possible, which means that the cracking coil must be designed for a low pressure drop. To keep the residence time at the cracking temperature to a minimum, gas velocities are necessarily very high in the last portion of the cracking coil.

The original cracking furnace design stipulated the cracking of 642,327 lbs./d (8,143,000 cu. ft./d at 14.7 psia and 60° F.) of a propane-ethane mixture. Three identical cracking furnaces connected in parallel were determined to be the most practical design for the charge rate desired. Each furnace (refer to Fig. 1) has two parallel convection and radiant coils, thus the total designed furnace feed of 642,327 lbs. is divided into six equal parts.

To obtain certain economies in design, each furnace has two separately fired combustion chambers housing the radiant coils, and a common convection section housing the two convection coils. Heat is supplied by gas burners arranged horizontally along each side wall of the combustion chambers. The flue gases flow from the combustion chambers over the bridgewalls and thence downwardly into the convection section passing out of the furnace through an underground duct to a stack. Principal dimensions of each furnace are shown in Fig. 1.

The designed feed composition and volume charged to *one-half* of one furnace are shown in Table 3.

On the basis of previous pilot plant work, a reaction temperature of 1500° F. was selected for design purposes. From the earlier experimental work, the cracked gas yield and composition were calculated to be as given in Table 4.

At this point, mention should be made of the fact that the furnace was purposely designed on a conservative basis. Since, at a fixed feed rate, the amount of heat required is variable depending upon the temperature at which the cracking is effected (i.e., depth of cracking), as well as the feed composition, considerable flexibility with respect to the composition of the feed that could be handled was desired. Therefore, since higher temperatures are required to crack ethane than propane at comparable conversion levels, a feed stream analysis was chosen for design purposes containing the greatest percentage of ethane that was anticipated would ever be charged to the unit.

TABLE 6—Summary of Cracking Furnace Design

	Three Furnaces	One Half Furnace
Feed, lbs./day	642,327	107,055
Stream temperatures, ° F.:		
Inlet convection section	100	100
Inlet radiant section	1,290	1,290
Outlet radiant section	1,500	1,500
Stream pressures, psig:		
Inlet convection section	44	44
Inlet radiant section	20.6	20.6
Outlet radiant section	10	10
Heat requirements, Btu./hr.:		
Reaction heat	18,500,000	3,080,000
Sensible heat	30,000,000	5,000,000
Total	48,500,000	8,080,000
Heat distribution in furnace: Btu./hr.:		
Radiant coil:		
Reaction heat	18,500,000	3,080,000
Sensible heat	6,000,000	1,000,000
Convection coil sensible heat	24,000,000	4,000,000
Radiation loss from radiant section	2,910,000	485,000
Radiation loss from convection section	1,940,000	323,000
Lost in stack gases	43,650,000	7,275,000
Total	97,000,000	16,163,000
Fuel gas requirements(1), cu.ft./hr.: @ 14.7 psia and 60° F.	100,000	16,700
Furnace temperatures, ° F.:		
Flame temperature	2,250	2,250
Bridgewall	1,670	1,670
Bottom of stack	1,000	1,000

Furnace Tubes:	Radiant Coil	Conv. Coil	Radiant Coil	Conv. Coil
Surface required, sq. ft.	4,082	4,080	681	680
Size, ins.	5.5 x ¼	4 x ¼	5.5 x ¼	4 x ¼
Length, ft. and ins.	20-0	20-0	20-0	20-0
Eff. heating length, ft. and ins.(2)	18-3	18-3	18-3	18-3
Number:				
Pre-heat	38.1	216	6.35	36(5)
Reaction	117.9		19.65	
Total	156.0	216	26.00	36(5)
Alloy	25-20	18-8(3)	25-20	18-8(3)

	Radiant Coil Reaction Section	Radiant Coil Preheat Section	Conv. Coil	Total
Pressure drop and residence time:				
Pressure drop, psi	9.75	1.83	23.35	35.93
Residence time, sec.	1.37	0.74	4.47	6.58

Stacks:

Three stacks 4 ft.-6 ins. diameter, 90 ft.-0 ins. high (one on each furnace)(4)

(1) Net heating value, 970 Btu./cu. ft.

(2) A few inches of the ends of each tube are enclosed in the return bend header boxes which are isolated from the body of the furnace, thus decreasing the actual tube length available for heat transfer.

(3) Two top rows of tubes in convection section 25-20, remainder 18-8.

(4) Volume of flue gases based on 100 per cent excess air: 714,250 cu.ft./hr./furnace (14.7 psia and 60° F.).

(5) In furnace as erected, 37 convection tubes were actually installed.

TABLE 7—Propane-Ethane Cracking Furnace Test Runs

(All data for one-half furnace)

Test Number	1		2		3		4	
Operating Conditions:								
Pressures, psig(1):								
Furnace Inlet	34.0		35.4		37.8		39.4	
Furnace Outlet (After Air Fin Cooler)	...		3.6		4.1		4.2	
Temperatures, ° F.								
Furnace Inlet	65		72		85		87	
Outlet Convection Section			1308		1330		1350	
Outlet Radiant Section(2)	1230		1253		1298		1319	
Calculated Reaction Temperature(3)	1407		1428		1464		1471	
Feed Composition:	Wt. %	Mol. %	Wt. %	Mol. %	Wt. %	Mol. %	Wt. %	Mol. %
Component								
CH_4	3.66	8.86						
C_2H_6	15.69	20.26						
C_3H_8	79.98	70.43	Same as Test No. 1		Same as Test No. 1		Same as Test No. 1	
C_4's	.67	.45						
	100.00	100.00						
Specific Gravity (air = 1.000)	1.343							
Cu.Ft./Day at 14.7 psia, 60° F. (Metered)	1,034,000		1,037,000		1,025,000		1,022,000	
Product Composition:								
Component								
H_2	1.22	14.83	1.35	15.45	1.62	16.79	1.85	18.57
CH_4	20.43	31.29	24.03	34.65	31.87	41.43	37.02	46.81
C_2H_4	23.44	20.54	28.81	23.78	32.73	24.34	30.31	21.93
C_2H_6	14.92	12.19	15.05	11.58	14.72	10.21	8.96	6.04
C_3H_6	14.15	8.27	11.04	6.57	7.14	3.54	2.57	1.42
C_3H_8	19.11	10.65	19.25	5.38	2.77	1.31	1.91	0.88
C_4's	2.98	1.26	3.27	1.30	2.68	0.96	5.27	1.84
C_5's+	3.75	0.97	5.50	1.29	6.47	1.42	11.71	2.50
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Unsaturates (Bromine Orsat)	33.4		34.7		34.0		29.0	
Specific Gravity (air = 1.000)	0.850		0.880		0.721		0.701	
Cu.Ft./Day at 14.7 psia, 60° F.	1,630,000		1,745,000		1,945,000		1,949,000	
Lbs./Day	106,000		106,000		105,000		104,000	
Conversions (Smoothed Values from Curves):								
Lbs. C_2H_6 Destroyed per 100 lbs. C_2H_6 Feed	3.1		3.8		15.2		34.3	
Lbs. C_3H_8 Destroyed per 100 lbs. C_3H_8 Feed	77.0		86.1		96.5		97.6	
Lbs. $C_2H_6+C_3H_8$ Destroyed per 100 lbs. $C_2H_6+C_3H_8$ Feed	65.1		72.4		83.7		86.6	
Efficiencies (Smoothed Values from Curves):								
Lbs. $C_2H_4+C_3H_6$ Produced per 100 lbs. $C_2H_6+C_3H_8$ Destroyed	60.4		58.8		49.9		40.1	
Yields:								
Lbs. $C_2H_4+C_3H_6$ Produced per 100 lbs. $C_2H_6+C_3H_8$ Feed	39.3		42.5		41.7		34.8	
Calculated Residence Times, Sec.:								
Convection Section	5.35		5.45		5.66		5.78	
Radiant Preheat Section	0.90		0.92		0.95		0.98	
Radiant Reaction Section	1.82		1.76		1.69		1.70	
Total	8.07		8.13		8.30		8.46	

(1) Barometric pressure, 13.2 psia.
(2) Fourth tube from outlet of furnace.
(3) Reaction temperatures calculated using propane cracking velocity constants.

Concerning the effects of feed composition, ethane is less reactive than propane, and methane is less reactive than ethane. Methane is considered simply as a diluent under the operating conditions used. However, the methane content should be kept to as low a value as practical since its presence increases the size of the equipment and, of course, contributes to increased operating costs. Since butane and heavier paraffinic hydrocarbons crack much more readily than propane or ethane, their concentration should be kept very low (less than 2%) as some of their decomposition products degrade rapidly into tar and coke at the temperatures used for propane-ethane cracking. The propylene and ethylene concentration in the feed should also be held as low as possible to prevent a loss in product since not only are these olefins partially decomposed in the cracking reaction, but also they "back out" additional fresh propane-ethane feed stock.

If sulfur compounds are present in the feed, they will crack in much the same manner as the hydrocarbons and sulfur compounds will appear in the products. If sulfur compounds are undesirable in the process in which the ethylene, or propylene, are to be utilized, it will generally be desired to desulfurize the propane-ethane feed stock before charging it to the cracking furnaces. Also, it will generally be desirable to dry the propane-ethane feed to the cracking furnaces, using bauxite or some other suitable drying agent. To prevent "freeze-ups" it is, of course, absolutely essential that the cracked gas contain no water if low temperature (refrigerated) fractional distillation processes are used to recover and purify the ethylene. It has been found that if bauxite dryers are used downstream of the cracking furnaces the bauxite becomes fouled rather rapidly by polymers thereby causing low dryer efficiency and frequent bauxite regeneration.

Returning to the original design calculations, heat balances for cracking furnace design purposes were based on the following premises:

(1) 50 per cent over-all thermal efficiency.
(2) Total radiation loss 5%, with 3% lost in radiant section, and 2% lost in convection section.
(3) Approximately 25% of total heat released to be absorbed in radiant section, and 25% to be absorbed in convection section.

The sensible heat required to raise the feed stream (to one-half of one furnace) from 100 to 1500° F. was calculated to be 5,000,000 Btu's per hour. The measured heats of reaction, 1570 and 785 Btu/lb. for ethane and propane, respectively, at 60% ethane cracked per pass, and 90% propane cracked per pass, resulted in a total heat of reaction of 3,080,000 Btu/hr. Thus, the total reaction heat and sensible heat requirements were 8,080,000 Btu/hr. In the design calculations it was assumed that all of the heat of reaction and a part of the sensible heat would be added in the radiant section. Heat input in the radiant section was limited to 6,000 Btu/hr./sq. ft. of external tube surface.

Based on the aforementioned design premises and calculated heat requirements, the designed heat distribution in one-half of one cracking furnace was as given in Table 5.

The pressure at the outlet of the radiant section was set at approximately 10 psig. (maximum) to permit passing the cracked gas through downstream heat exchange and carbon removal equipment to the compression system. The allowable pressure drop through the reaction section of the radiant coil was set at approximately 10 psi, to minimize thermal polymerization reactions.

Space limitations do not permit

a detailed presentation of the various calculation methods used to arrive at all of the factors entering into the design of the cracking furnaces. However, a summary of the more pertinent design factors is given in Table 6.

Reference to Table 6 shows that each convection coil contains 37 tubes 4 in. O.D. by ¼ in. average wall thickness, and each radiant coil contains 26 tubes 5½ in. O.D. by ¼ in. average wall thickness. As originally designed, the convection tubes, with the exception of the top two rows, were fabricated from heat stabilized type 304 (18-8 Cr-Ni) alloy. The remainder of the tubes originally were of type 310 (25-20 Cr-Ni) alloy. The return bends were attached to the tubes by welding because of the anticipated difficulty of maintaining tight joints by the use of rolled or bolted headers. The return bends were cast of 18-8 and 25-20 Cr-Ni alloy using 8-in. center-to-center tube spacing in the convection section and 11-in. spacing in the radiant section.

With this double chambered furnace design, it is possible to operate each half of the furnace independently and to make repairs to one radiant coil while the other coil is in service. Under such conditions, the idle half of the tubes in the convection section become heated to the temperature of the flue gas from the operating side and this must be taken into consideration when selecting the alloy for the convection tubes.

Fully suspended wall refractories are used to line the combustion chamber and bridge wall, with the individual first-quality firebrick tile hung on heat resisting Meehanite castings bolted to the structurals. All tube sheets are cast in 25-12 Cr-Ni alloy, insulated on the fire side with a high temperature castable refractory and attached to the frame of the furnace in a manner which permits free expansion of each casting in three directions. The underground flue gas duct and base portion of the stack are insulated with a lightweight castable insulating refractory.

The other equipment connected with this process (refer to Fig. 1) will only be described briefly, since it is more or less conventional and is subject to modification in any particular installation depending upon the desired process use for the cracked gas products. The furnace effluent gases pass through carbon catchers, where a portion of the small amount of carbon formed in the cracking coil drops out, and then through air fin coolers wherein the temperature of the cracked gas is reduced to about 250° F. The cooled gas is then passed through "Cycoil" oil scrubbers to remove any remaining finely divided carbon particles from the gas stream to prevent fouling of downstream heat exchanger and compression equipment.

From the "Cycoil" gas cleaners, the gas stream flows to atmospheric water cooling tower coils where its temperature is reduced to near atmospheric. The gas is then compressed in three stages to about 800 psig. After compression the cracked gas is passed to an aromatic oil removal column (not shown) and to a high pressure—low temperature absorption and fractionation system (not shown) wherein olefinic fractions of the cracked gas are extracted and purified.

Plant Operating Data

During the initial operating period of the cracking furnaces described herein, test runs were made to determine the effect of cracking depth on the composition and yield of the cracked gases and operability of the furnaces using a feed stock representative in quantity and quality to that normally available. The test data are summarized in Table 7.

As shown in Table 7 four test runs were made on one-half of one furnace wherein the feed composition and feed rate were held essentially constant and the depth of cracking was progressively increased by increasing heat input to the furnace. The feed rate closely approximated that used

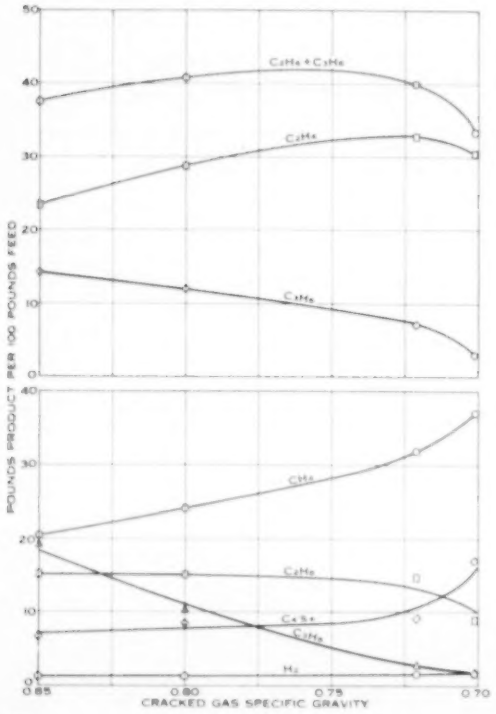


Fig. 2 (left)—Products from thermal cracking of propane-ethane mixture vs. cracking depth

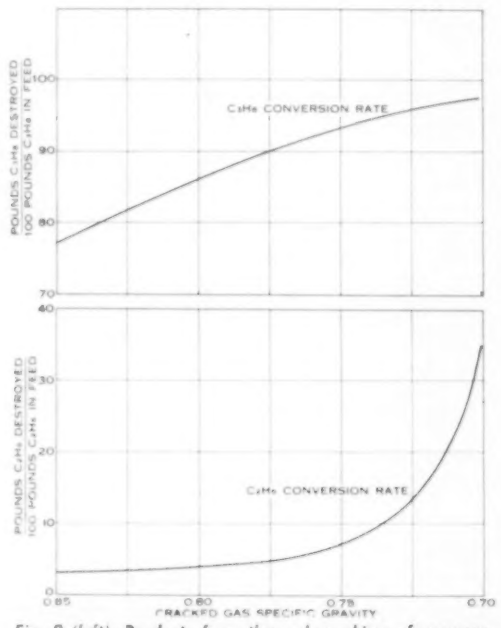
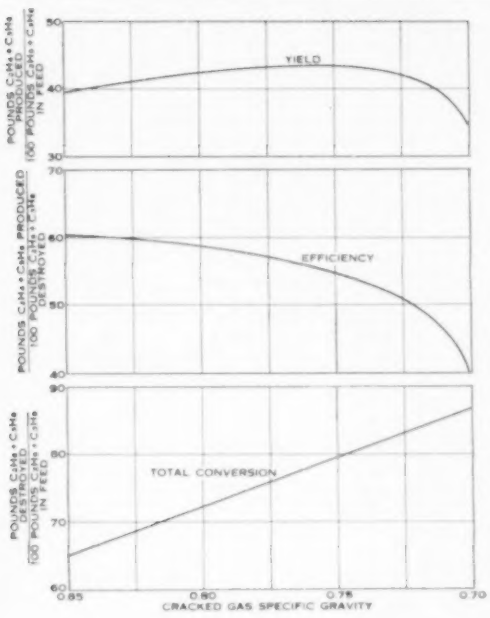


Fig. 3 (above)—Variation of propane and ethane conversion rates with depth of cracking



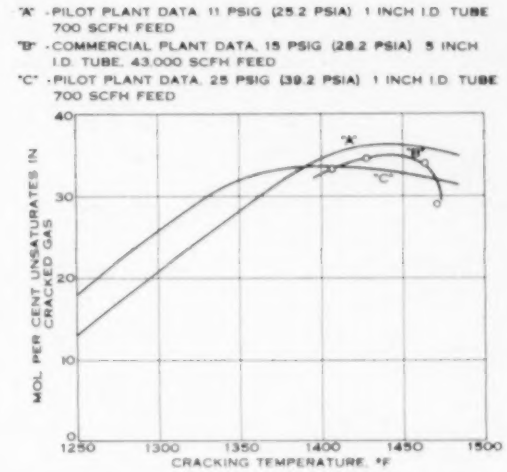

"A" - PILOT PLANT DATA, 11 PSIG (25.2 PSIA) 1 INCH I.D. TUBE 700 SCFH FEED
"B" - COMMERCIAL PLANT DATA, 15 PSIG (28.2 PSIA) 5 INCH I.D. TUBE, 43,000 SCFH FEED
"C" - PILOT PLANT DATA, 25 PSIG (39.2 PSIA) 1 INCH I.D. TUBE 700 SCFH FEED
MOL. PER CENT UNSATURATES IN CRACKED GAS
CRACKING TEMPERATURE, °F
1250
1300
1350
1400
1450
1500

Fig. 4 (left)—Effect of cracking depth on conversion rate, efficiency and yield

Fig. 5 (above)—Comparison between commercial and pilot plant thermal cracking of propane-ethane mixtures

in the original design calculations. The feed composition was much richer in propane than the feed analysis chosen for original design purposes; thus, reaction temperatures were somewhat below the designed maximum temperature of 1500° F., ranging from 1407° to 1471° F.

The first test run was made at a furnace effluent cracked gas specific gravity of 0.850. Subsequent samples were taken at cracked gas specific gravities of 0.800, 0.721 and 0.701. It will be noted that the charge gas volume in all tests was approximately 1,000,000 cu. ft./day, but that the volume of furnace effluent gas, due to the progressively severe cracking conditions, increased from 1,630,000 cu. ft./day in Test No. 1 to 1,949,000 cu. ft./day in Test No. 4. This progressive volume increase of the cracked gas was reflected by the progressively decreasing cracked gas specific gravities.

Since, for any given feed stock composition, the specific gravity of the cracked gas is a measure of the amount of propane and ethane cracked per pass, and can be obtained by means of a continuous recording gravitometer, for furnace control purposes this method of determining depth of cracking was used rather than reaction tube temperature measurements which are extremely difficult to obtain with the desired degree of accuracy. In the latter connection, it will be noted from Table 7 that a thermocouple which was affixed to the fourth tube from the outlet of the radiant section read approximately 175° F. lower than the reaction temperature calculated to have existed from the analytical data on gas compositions and experimental propane cracking velocity constants.

Although considerable effort was expended in attempting to obtain true tube temperatures by means of thermocouple measurements, such readings were generally found to be too unreliable for day in and day out control purposes. Conversely, cracked gas gravitometer readings were found to be generally satisfactory as judged from comparisons of the calculated effluent gas specific gravities from low temperature fractional analyses with gravitometer instrument readings, and were sufficiently sensitive for control purposes.

From the data presented in Table 7, a plot of the yields of products obtained per 100 lbs. of charge stock at various cracking depths was constructed (refer to Fig. 2). It is apparent that the maximum yield of ethylene was obtained at a cracked gas specific gravity of about 0.725. The maximum combined yield of ethylene plus propylene occurred at a cracked gas specific gravity of approximately 0.75.

As the temperature was increased (as reflected by progressively decreasing cracked gas specific gravities), the propane conversion rate (defined as pounds of propane destroyed per 100 pounds of propane in the feed) progressively increased from 77.0 to 97.6; the ethane conversion rate (defined as pounds of ethane destroyed per 100 pounds of ethane in the feed) progressively increased from 3.1 to 34.3. A plot of the propane and ethane conversion rates versus cracked gas specific gravity, as derived from smoothed values of the test data, is shown in Fig. 3.

Reference to Table 7 will show that the total propane plus ethane conversion rate (defined as pounds of propane plus ethane destroyed per 100 pounds of propane and ethane in feed) increased from 65.1 to 86.6. Over the same temperature range, the efficiency (defined as pounds of ethylene plus propylene produced per 100 pounds of propane plus ethane destroyed) decreased from 60.4 to 40.1, falling off rather rapidly as the depth of cracking was increased. The yield (defined as pounds of ethylene plus propylene produced per 100 pounds of ethane plus propane in the feed) varied from 39.3 to 34.8, passing through a maximum of about 43.5 at a cracked gas specific gravity of 0.75. A plot of the above described conversion, efficiency and yield values, as derived from smoothed values of effluent gas composition, is shown in Fig. 4.

As a matter of interest, the furnace reaction section temperatures for the various tests were calculated from the reaction section residence times and the corresponding propane conversion rates by proper substitution in equation (4) to obtain the observed cracking velocity constants; the observed cracking velocity constants were then substituted in equation (5) to obtain the cracking tem-

peratures. A comparison was then made of the commercial propane-ethane cracking test results with the experimental results obtained in the pilot plant. This comparison is shown in Fig. 5.

The pilot plant data shown in Fig. 5 were obtained by cracking propane-ethane mixtures in a furnace having a 240 ft. cracking coil of 1 in. I.D., 25-20 chromium-nickel stainless steel pipe. The pilot plant charge gas was comprised of approximately 77% propane, 19% ethane and 4% methane, by volume. The tests were made at a constant feed rate of 700 cu. ft./hr. and at the average pressures indicated on Fig. 5.

The cracking temperatures shown in Fig. 5 refer to measured tube wall temperatures in the case of the pilot plant data, in the case of the commercial data, the temperatures refer to those calculated from experimental propane cracking velocity constants as the thermocouple measuring the commercial unit reaction section temperature read about 175° F. low, as mentioned earlier. The cracked gas stream in the pilot plant tests was analyzed for total unsaturate content by absorption of the olefins in bromine water in an Orsat apparatus. Therefore, to make the data comparable, the commercial unit cracked gas, total unsaturate content, as obtained from the bromine Orsat data reported in Table 7, were also used in constructing Fig. 5.

Inspection of Fig. 5 will show that good agreement was obtained between the pilot plant and commercial results. (Since the feed stocks and contact times were not exactly alike, the results are not directly comparable except in a qualitative way.) It will be noted that the commercial test results, conducted at an average reaction section pressure of 28.2 psia, fell between the pilot plant tests at 25.2 and 39.2 psia; also, that the maximum yield of unsaturates obtained in the commercial test at 28.2 psia occurred at about the same temperature level as did the pilot plant tests at the 25.2 psia pressure level. It is interesting to note the rather marked effect of pressure on the unsaturate content of the cracked gas as shown by the pilot plant data.

From a standpoint of maximum yield of ethylene (charging the quality of feed described herein), it would be desirable to operate the cracking furnaces at a cracked gas specific gravity of about 0.725 (see Fig. 2). However, from an operational standpoint, such an extremely deep cracking rate is most undesirable due to difficulties occasioned by increased tar, coke and carbon formation. Because of the increased formation of light oils and their subsequent deterioration to tar and coke at the deeper cracking rates, the furnace tubes and the return bends plug rather quickly thus necessitating frequent furnace shutdowns for burning out this material.

If coke deposition is allowed to progress too far, not only will the tubes be overheated (due to the insulating effect of the coke inside the tubes) thus causing serious damage, but the tubes may rupture because of excessive back pressure caused by coke build-up. Also, the deeper cracking rates will cause the air fin coolers and lines to the carbon scrubbers to become plugged with large amounts of coke, carbon and a tarry material ranging from a semi-fluid plastic to a solid state. Therefore, to avoid the deposition of this material, which, of course, is extremely difficult, time consuming, and expensive to remove, the cracking furnaces are normally operated in the range of about 0.80 to 0.85 cracked gas specific gravity.

At this cracking depth the effluent gas contains only rather small quantities of a "fluffy" finely-divided carbon much like soot, along with only small amounts of tar and coke, which are easily removed periodically. Their removal is ordinarily accomplished by shutting off the propane stream and passing an air and steam mixture through the tube coil until the coke, etc., is burned away. As mentioned previously, one side of one furnace can be cleaned while the other is operating; thus, with three furnaces in operation, the total cracked gas stream is only decreased one-sixth while the burn-out operations are being accomplished. Normally each coil is cleaned using the above procedure about every two weeks, the operation requiring approximately eight hours. The subject of tube cleaning will be discussed in greater detail later in this paper.

For a design furnace outlet temperature of 1500° F., it was calculated that tube metal temperatures would approximate 1600° F. in the radiant section during normal operation, with higher temperatures obtaining in the event of heavy fouling of internal surfaces. Some actual tube* and bridgewall refractory temperatures observed with an optical pyrometer at a time when the unsaturate content of the cracked gas stream analyzed 34% are given in Table 8.

Fig. 6 shows the results of a thermocouple survey of return bend temperatures and flue gas temperatures taken under rather mild cracking conditions (the unsaturate content of the cracked gas analyzed 27.5%). Thermocouples attached to return bends in the header boxes do not furnish true tube metal temperatures but, if the hot junctions are well insulated, reasonably accurate and consistent data can be obtained.

TABLE 8—Observed Actual Tube and Bridgewall Refractory Temperatures

Tube Number From Outlet	Tube Temp., °F.		Bridgewall Temp., °F.
1	1490	Top	1705
5	1595	Bottom	1765
10	1550		
15	1605		
20	1650		
25	1675		

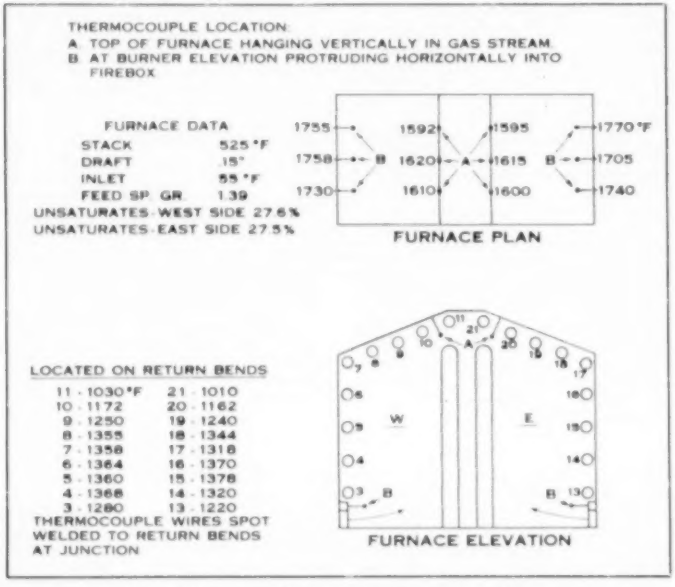
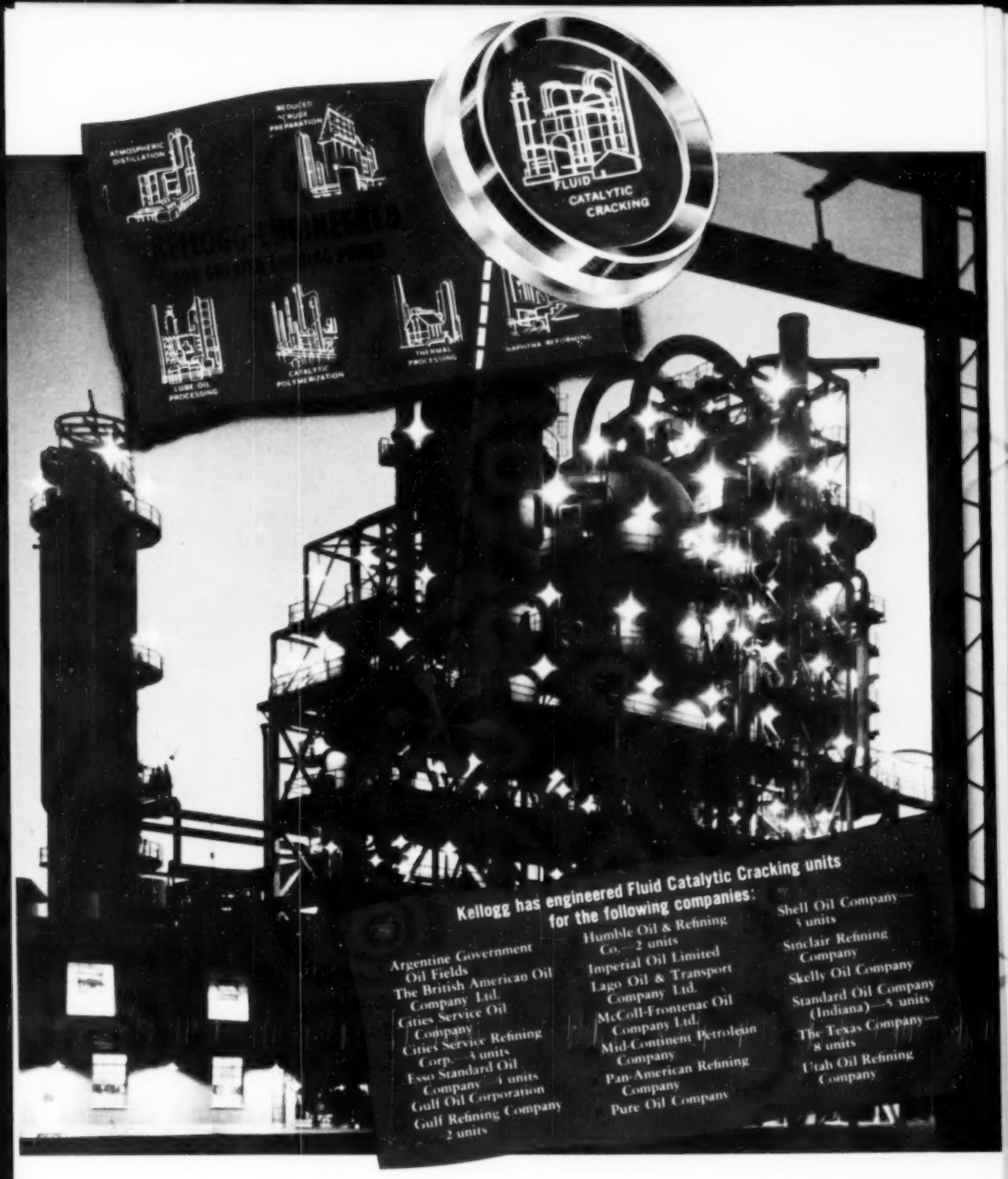


Fig. 6—Thermocouple survey, gas cracking furnace

* In this paper, the tubes are numbered consecutively from furnace inlet to furnace outlet unless otherwise stated.


ATMOSPHERIC DISTILLATION
REDUCED CRUDE PREPARATION
LUBE OIL PROCESSING
CATALYTIC POLYMERIZATION
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Esso Standard Oil Company—4 units
Gulf Oil Corporation
Gulf Refining Company—2 units
Humble Oil & Refining Co.—2 units
Imperial Oil Limited
Lago Oil & Transport Company Ltd.
McColl-Frontenac Oil Company Ltd.
Mid-Continent Petroleum Company
Pan-American Refining Company
Pure Oil Company
Shell Oil Company—4 units
Sinclair Refining Company
Skelly Oil Company
Standard Oil Company (Indiana)—4 units
The Texas Company—8 units
Utah Oil Refining Company

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Two full-scale pilot plants now operate at the Kellogg laboratories, supplementing operating reports from the numerous Kellogg commercial units. In addition, many separate studies are continually conducted on such subjects as the composition of the fluid bed at any particular point under varying operating conditions—the effect of internal and/or external stripping of catalyst from cracked oil vapors—the effect of catalyst erosion on pipe bends of various contours—the life of various types of refractories used as interior vessel linings. Yes, these and numerous other studies are regularly undertaken in order to make the next Kellogg FLUID "Cat" just a little better than its predecessor—a little more profitable for its owner.

IT TAKES ALL SEVEN TO PRODUCE GREATER EARNING POWER...

1 THE DEVELOPMENT "TOOLS"
—laboratories, pilot plants and recognized specialists to prove and improve processing and equipment ideas.

2 PROCESS ENGINEERING
by three distinct groups of specialists—*sequence* engineers, *unit* engineers and *development* engineers—supported by an extensive reservoir of exclusive data.

3 SPECIALISTS IN EVERY PHASE
of design engineering due to the completeness of Kellogg's engineering staff.

4 SPECIALIZED BUYERS
backed by the cumulative buying power of the largest company in the business.

5 COMPLETE FABRICATING FACILITIES
to make schedule deadlines and to develop workable "firsts" in refinery equipment. The value of the former and its effect on construction costs is easy to understand. The second point is well demonstrated by the GIANT PIPE BENDER pictured here. Catalyst pipes on "Cat" Crackers are exposed to severe erosion. Ordinary segmented bends only increase the erosive action. To solve this problem, Kellogg shops created this exclusive device on which pipe up to 96 inches in diameter can be bent, providing a smooth interior contour that minimizes catalyst erosion.

6 CONSTRUCTION KNOW-HOW
acquired in completing hundreds of major jobs, plus an ample supply of the proper tools, and the constant development of new money-and-time-saving methods on the construction lot.

7 PRACTICAL OPERATING COUNSEL
on all design and construction, achieved through practical operating men working as an integral part of the company.

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Plant Practices

Practical Tips and Ideas for Improving Operations

Barge Loading Operation Is Improved By Revising Way of Using Lift Truck

A MORE direct method of loading full oil drums on barges at high tide with a fork lift truck at the Bayonne, N. J., refinery of Tide Water Associated Oil Co. has resulted in a considerable saving in man-hours. In addition, it has permitted a much needed piece of equipment to be free for other material handling jobs in the plant.

The problem which existed prior to the improvement was as follows. At high tide, the decks of the drum transporting barges were above the top of the dock bulkhead, as can be seen in the upper sketch in Fig. 1. The drums were delivered from the warehouse by a fork lift truck to the barrel loading machine, which was used to elevate the drums to the height of the sloping skid, supported by the loading machine and the deck of the barge.

It was necessary to have a man at the loading machine to position drums for pickup by the endless belt on the machine. However, this loading machine also was used for packing boxcars and transport trucks, and often it had to be shifted from one job to another. This required the efforts of several men and sometimes made it extremely difficult to schedule simultaneous loading of both boxcars and barges.

The solution to the problem is shown in the lower sketch in Fig. 1. Two stanchions with an adjustable cross-bar were installed on the dock bulkhead. The skid was then placed with one end on the cross-bar and the other on the barge. The operator of the fork truck now simply elevates the drum to the skid and allows it to roll onto the barge without further handling.

This suggestion has simplified drum loading of barges under all tide conditions and has released men for other work.

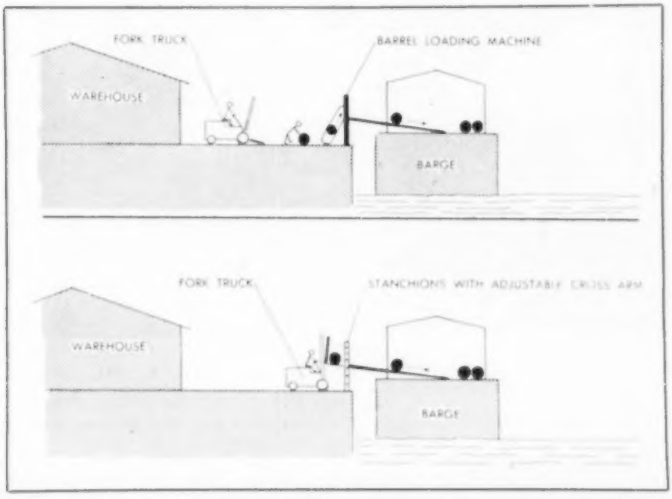

Fig. 1—Above: old method of loading drums on barges at Tide Water's Bayonne refinery took two men. Below: new method uses one man and releases loading machine for other work

Simple Method Saves Time Replacing Seal Liquid in Instrument Installations

A FAST, simple method for refilling instrument hook-ups with seal liquid as practiced by California Refining Co. at its Perth Amboy, New Jersey, refinery is illustrated in the sketch in Fig. 2.

The fresh stock of sealing liquid is brought to the instrument installation in a small, cylindrical container made of a length of fairly large diameter pipe with each end enclosed by welding on a disk of metal. The container is equipped with a gage glass, drain line, fill plug, draw-off line of ¾ or 1-in. pipe, and an inlet for compressed air.

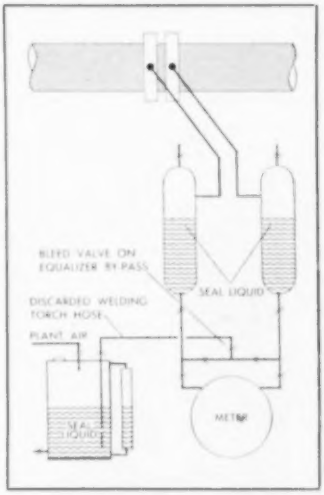

Fig. 2—California Refining Co.'s arrangement for refilling instrument hook-ups with seal liquid

In use, it is connected to the bleed valve on the equalizer by-pass of the meter hook-up by means of a piece of acetylene welding torch hose. The compressed air inlet is connected to any convenient plant air outlet. Plant instrument department men find the method considerably faster than any previous technique employed for replenishing the seal liquid on meter installations around the refinery.

Magnetic Level Controller Is Tested Rapidly without Removal from Vessel

By J. T. RECORD, Phillips Petroleum Co.

A simple method of isolating a "Magnetrol" liquid level controller and testing it for proper operation and adjustment involves a minor rearrangement in equalizing lines between the tank and the control, and a 5 gal. utility can complete with pump and connection to allow filling and emptying the control for testing.

The normal procedure in connecting this type of controller to tanks is to install equalizing lines between tank and controller without sufficient valves to allow complete isolation of the unit. This makes it next to impossible to check the unit thoroughly when it is in operation.

The installation of plug valves in the equalizing lines, a bleeder valve at the top of the controller and a drain and fill connection will permit the unit to be tested thoroughly at any time without removing it from the vessel, thus providing a considerable saving in testing time.

The test apparatus consists of a 5 gal. utility can equipped in any desirable way with a plunger type pump and connections to allow pumping the liquid through the Magnetrol controller is isolated from the vessel back to the can. The Magnetrol level controller is isolated from the vessel by closing plug valves in the equalizing piping. The control then is drained of liquid into another can if the tank liquid is not to be used in testing the instrument. The test liquid, which should have approximately the same specific gravity as the liquid in the tank, then is pumped in to the desired level or quantity. The control then can be examined for proper indication and the necessary adjustments made. The test liquid then is drained into the test can, the bleeder valve closed and the plug valves re-opened to restore the unit to service.

IDEAS—Wanted!

Plant superintendents, foremen, engineers, chemists, researchers, technicians—Send in your own ideas on "How we do it in our refinery," or "How we do it around our laboratory."

Possible subjects could include special apparatus, gadgets, tools, shortcut methods, time and money savers, accident and fire prevention schemes. The idea is the important thing—we'll dress up your drawings or photographs and write up your data. Material which has been submitted for publication exclusively in PETROLEUM PROCESSING will be paid for at the usual space rates. Send your ideas and contributions to:

Plant Practices Editor

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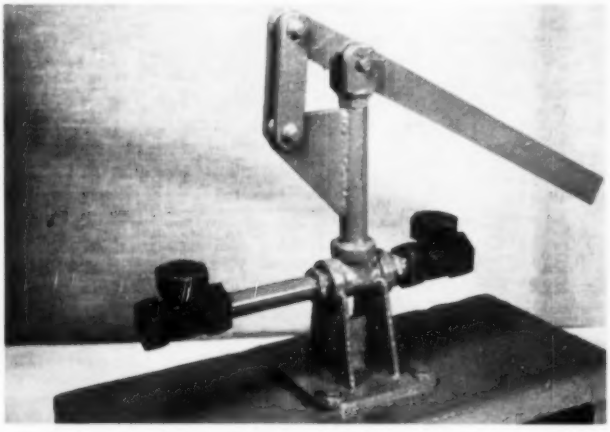
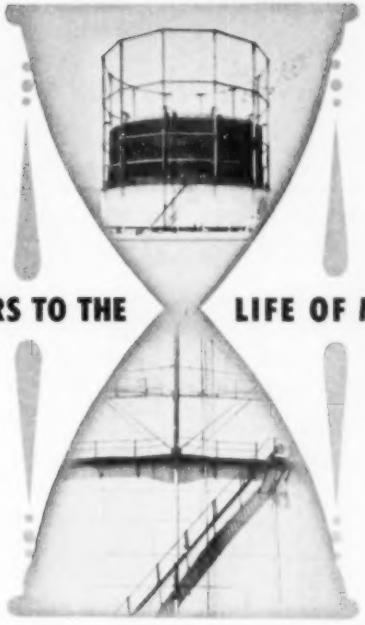
Cleveland 13, Ohio

Ordinary Washer Gives Good Seal in Test Pump



MAINTENANCE men at Socony-Vacuum Oil Co.'s Paulsboro, N. J., refinery have fabricated a simple portable hydraulic test pump using two piston or swing check valves, a cylinder made of double extra heavy pipe, and a piston made of cold rolled steel shafting. The completely assembled hydraulic test unit is illustrated in the photograph at the right above.

An enlarged detail of the cylinder top is illustrated at the right. An ordinary garden hose washer has been inserted in a recess in the top of the cylinder. This eliminates the need for either a stuffing box or a packing gland. The design is such that increased pressure in the cylinder increases the tightness of the seal between the rubber washer and the piston and the cylinder. Socony-Vacuum workmen have found pressures up to 1000 psi. may be obtained without any leakage.



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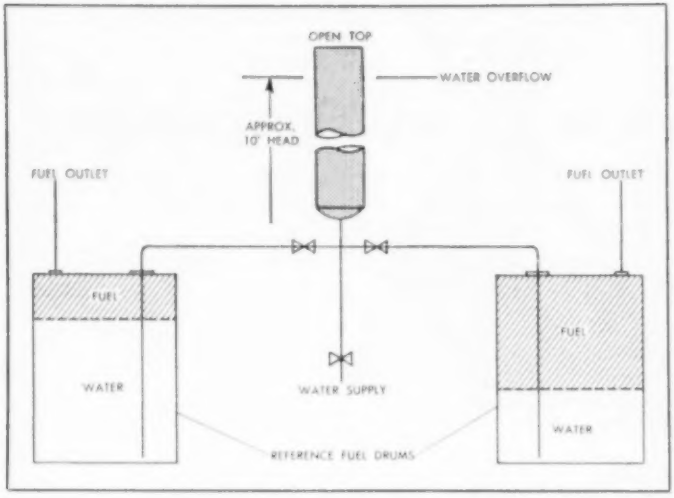
Water Displacement Device Provides Constant Head on Test Fuel Supply



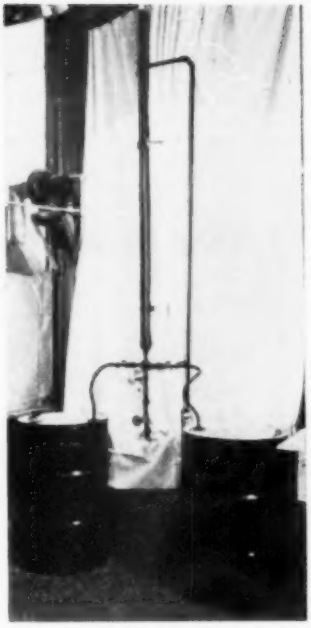


Fig. 1—Left: schematic diagram and right: photograph of reference fuel transfer apparatus

TO provide a low pressure, constant head on the reference fuel service lines in the fuel and engine test laboratory at the Cleves, Ohio, refinery of Gulf Refining Co., a simple, water-displacement device was designed and arranged for use with standard 55-gal. drums of the fuel. It is illustrated in the photograph and the schematic diagram, Fig. 1.

The constant head is provided by a vertical, open-top, 2-in. standpipe, through which plant water flows continuously from the bottom inlet to the overflow line to the sewer. Part of this flow is taken off at the four-way tee, and fed through plug cocks as desired to the fuel drums, where it gradually displaces the contents.

A careful check must be kept on the water level in the drum so as to avoid allowing water to enter the fuel service lines. If that does occur, the system must be blown out. Extra side taps in the water line, barely visible in the photograph, can be used to connect in other containers as they are needed.

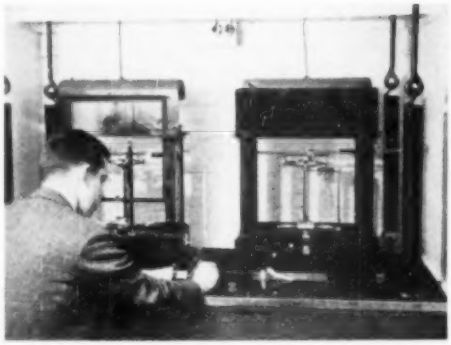
Balances Supported on Inexpensive Spring-mounted Table

AN inexpensive, spring-suspended table provides vibration-proof mounting for delicate analytical balances in the research laboratories of The Texas Co. at Beacon, N. Y. The unit shown in the photograph holds two balances.

Overhead support is in the form of two angle brackets, each comprising two 3 x 3 x ¼-in. angle iron legs; the vertical leg being 1 ft. 8 in. long and the horizontal, 2 ft. 1 in. long, welded together and tied at their ends by a 3 x ¼-in. flat bar. The vertical legs are secured to the back wall of the balance room with four ½-in. anchor bolts. The brackets are 3 ft. 6 in. apart.

Bolted across the horizontal legs of the brackets, parallel to the back wall, are two 3 x ½-in. flat bars 4 ft. 9 in. long, with slotted holes, 13/16 x 1½ in at the outer ends to receive the upper ends of the suspension spring supports.

The four suspension spring assemblies each comprise a spring approximately 1 ft. 10 in. long and two ⅝-in. diameter eye-bolts with 1-in. I. D. eyes. The lower bolts are 4½ in. long and screwed into the table top. The upper bolts are 21 in. long, threaded for 6 in. and fitted with two washers and two nuts each. The table proper is 1⅛ in. plate, 22½ in. wide by 4 ft. 8½ in. long, and is covered with linoleum.



ALCOA

Alcoa Heat Exchanger News

PUBLISHED BY THE ALUMINUM COMPANY OF AMERICA

HEAT EXCHANGER SAVINGS $50,000

Many plants now save up to 80% of their tube costs!

A switch to Alcoa Aluminum Heat Exchanger Tubes can save 30%, 50% or 80% of your present tube expense, depending upon the type of tubes you now use. This amounts to a yearly savings of about $50,000.00 for the representative petroleum plant.

Roll-in of Alcoa Tubes is easily accomplished with standard tools and equipment. And aluminum's lightness speeds installation and fabrication.

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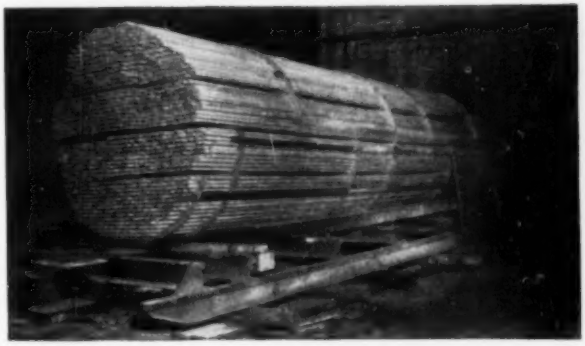
For complete information about Alcoa Tubes and name of your nearest supplier, call your local Alcoa sales office. Or write: ALUMINUM COMPANY OF AMERICA, 1493C Gulf Building, Pittsburgh 19, Pennsylvania.

* * *

ALUMINUM COMPANY OFFERS NEW BOOK

This new, 24-page booklet will answer many of your questions about Alcoa Tubes. It covers fabrication techniques . . . alloy selection . . . applications both chemical and petroleum. It describes tube cleaning, the use of inhibitors and methods of cathodic protection. It contains complete information on fluid flow and heat transfer characteristics, plus tables of physical properties and specification data. Write for your free copy, today. ALUMINUM COMPANY OF AMERICA, 1493C Gulf Building, Pittsburgh 19, Pennsylvania.



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This bundle contains 1780 Alclad (inside) tubes rolled into steel tube sheets. The unit condenses overhead vapors from a catalytic cracking unit to produce gasoline fractions. The product contains considerable hydrogen sulfide, also ammonia, carbon dioxide and steam. The cooling water is highly contaminated. Service like this is unusually corrosive to other heat exchanger tubes. But Alcoa Tubes remain clean, and sludge-free and corrosion is notably lacking.

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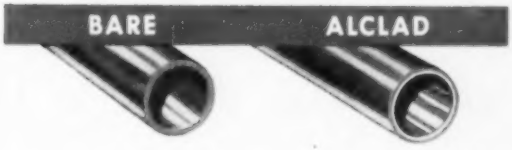

Now you can select the type of Alcoa Tube that best suits your application. Bare for product to product service. Alclad (inside) for contact with cooling waters. Both cost less than tubes of any other metal. Both offer additional savings in fabrication and installation.

[*To obtain more data on advertised products see page* 296]

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TECHNICAL PAPERS *and* ARTICLES

by

FLUOR RESEARCH *and* ENGINEERING PERSONNEL

Indicate the Subject by Number

1a **"Pulsation Phenomena in Gas Compression Systems"**

By: I. C. Bechtold, *Director of Research and Development*

Abstract: *Pulsation phenomena in gas transmission lines leading to and from gas compressor stations are described along with a description of the mechanical vibration induced from the pulsative flow.*

2a **"Effect of Pulsation on Gas Measurement"**

By: C. F. Yates, *Research Engineer*

Abstract: *This paper discusses the effect of pulsative flow on the accuracy of measuring gas flow rate by orifice meters. Data are presented showing the relationship between magnitude and nature of the pulse and the resultant readings recorded by the measuring instrument.*

3a **"Cooling Tower Maintenance"**

By: James O. DePlon, *District Engineer*

Abstract: *This article discusses the problems common to the maintenance of all cooling towers, and the best methods of accomplishing the maintenance work are discussed in detail. A recommended program of preventative maintenance is also presented, which should contribute towards reducing the over-all cost of owning a cooling tower.*

4a **"Fractionating Absorbers in the Petroleum Industry"**

By: J. C. Hannah, *Process Engineer*

Abstract: *Rapidly changing conditions necessitate familiarity with all methods now in use in the petroleum industry for separating mixtures of low-boiling hydrocarbons and associated compounds in order to obtain the most economic method for a given gas recovery and/or purification problem. This paper discusses one of these methods, i.e., fractionating absorbers. An example of application to actual plant data is shown.*

5a **"Evaluating Cooling Tower Performance"**

By: James O. DePlon, *District Engineer*

Abstract: *This article reviews the fundamentals of cooling tower design, and discusses in detail those factors affecting performance. Various curves are presented for estimating the size and performance of both Mechanical Draft and Atmospheric cooling towers. The factors affecting the selection of the various types of units are also discussed.*

6a **"Purification and Dehydration of Gases"**

By: C. L. Bloom, *Assistant Director of Research,* and W. F. Chapin, *Process Engineer*

Abstract: *This paper covers the chemistry and chemical engineering of regenerative processes for removing hydrogen sulfide and carbon dioxide from gases by use of amine processes together with their simultaneous or subsequent dehydration. In addition there is presented a description of the engineering features and operation of the Glycol-Amine plants which treat gas transported through the Texas-California line.*

7a **"A Critical Analysis of Methods of Determination of Water Dew Point in Hydrocarbon Gases"**

By: F. C. Riesenfeld, *Research Chemist,* and H. D. Frazier, *Research Chemical Engineer*

Abstract: *The authors have found that the values obtained from conventional dew point determination apparatus do not give true results when used on gases effluent from liquid dehydrators. A theoretical explanation for this phenomenon and a description of a method for determining the absolute water content of gases from this type of dehydrator is offered.*

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Patent Trends in Petroleum Refining

By Peter J. Gaylor, Editor "The Technical Survey"

Terpenes Aid Combustion Of Fuels for Rockets

ALTHOUGH many words are being written these days about rockets and their fuels, most of the pertinent information is in the classified category, and thus very little is available to the public at large on the technical phases of the subject.

One recent patent of interest along these lines is U.S. 2,489,051 issued to American Cyanamid Co. It deals with the use of terpenes as accelerators in the combustion of gasoline or diesel oil by nitric acid, ordinarily employed as an oxidant in rocket fuels. The terpenes are compounds of low freezing points and are capable of igniting spontaneously upon admixture with strong nitric acid. The terpene hydrocarbons such as the turpentines are preferred for this purpose. Good results are obtained when 96-99.5% or fuming nitric acid is used, and still better results are obtained when 28-30% of sulfuric acid monohydrate or 1-30% oleum are dissolved in the strong nitric acid.

Fig. 1 illustrates the effect of the addition of small amounts of sulfate turpentine to the gasoline-acid combustion mixture. It will be observed that, in the case of strong nitric acid, with or without sulfuric acid, only about 20% turpentine is needed in the gasoline to reduce the combustion lag down to the almost maximum amount. From Fig. 2, using diesel oil instead of gasoline, it is apparent that less turpentine is needed (about 10-15%) when 99.5% nitric acid is used with 15% oleum.

The efficacy of the terpenes as igniting agents and fuels in the generation of rocket propulsion can be demonstrated by a cup test in which suitable quantities of the oxidant are poured into a 4-in. evaporating dish containing the igniting agent. Upon adding quantities of 10-14 parts by volume of strong nitric acid to 7 parts of the terpenes, an immediate bright flash is obtained with a time lag of about 0.25 sec., accompanied by violent combustion with evolution of an intense bright flame.

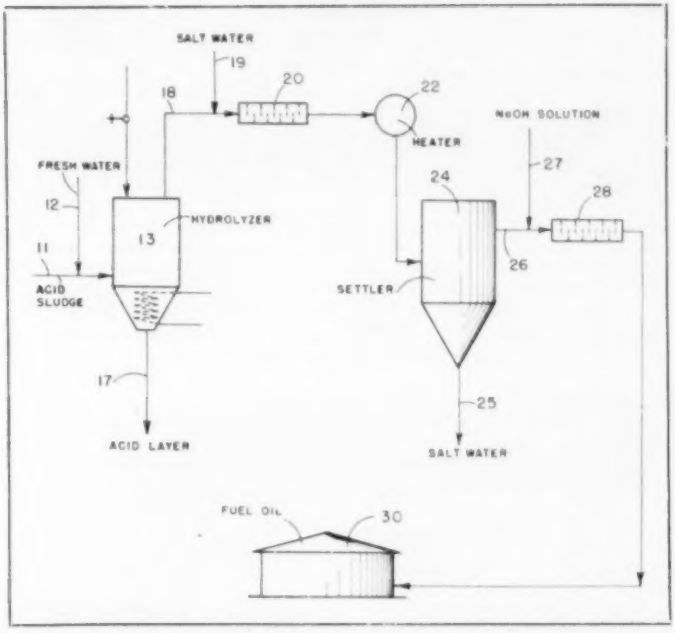


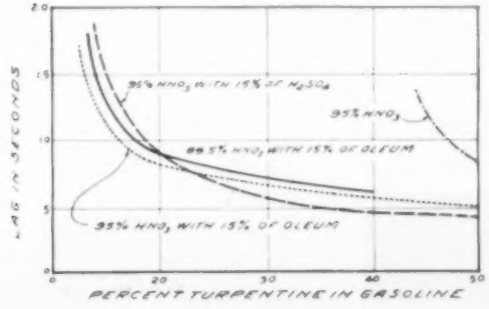
Fig. 3—Flow chart for Standard Oil Development's process for recovering and treating fuel oil from acid sludge (U. S. 2,487,103)

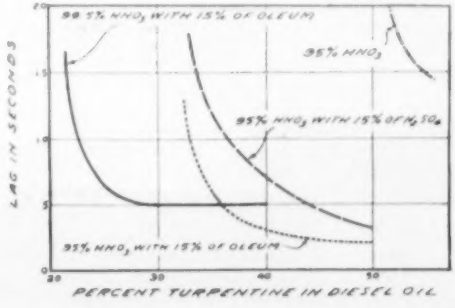
Fig. 1—Left: reduction of combustion lag by adding turpentine to gasoline

Fig. 2—Right: reduction of combustion lag by adding turpentine to diesel oil

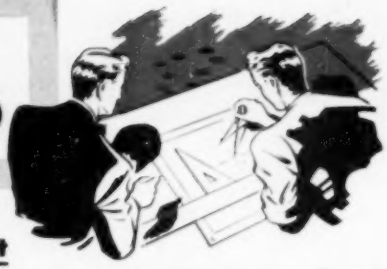
Fuels from Acid Sludge

REFINERIES usually accumulate large amounts of sulfuric acid sludge, particularly from treatment of heavy naphthas and lubricating oil. It is customary to hydrolyze such sludge to recover the acid, and the oil separated therefrom is employed as fuel. This oil, which is high in ash constituents and is acidic in nature, is often neutralized with sodium


LAG IN SECONDS
95% HNO3 WITH 15% OF H2SO4
95% HNO3
99.5% HNO3 WITH 15% OF OLEUM
95% HNO3 WITH 15% OF OLEUM
PERCENT TURPENTINE IN GASOLINE


LAG IN SECONDS
99.5% HNO3 WITH 15% OF OLEUM
95% HNO3
95% HNO3 WITH 15% OF H2SO4
95% HNO3 WITH 15% OF OLEUM
PERCENT TURPENTINE IN DIESEL OIL

ASK ADSCO



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This heater, with removable U-tube element, can be furnished in either horizontal or vertical design. Shells are fabricated, per A.S.M.E. Code, of copper silicon alloy, stainless- or nickel-clad steel, galvanized or black carbon steel. ADSCO corrosion resistant treatment adds life to black steel tanks.

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Patent Trends

hydroxide solution. The operation involves considerable trouble, particularly with emulsification, since the sulfonic salts formed are excellent emulsifying agents.

A patent issued to Standard Oil Development Co. (U. S. 2,487,103) describes a new method for reducing the ash of this oil without having to contend with the emulsification troubles usually encountered. According to the method disclosed, the sludge is first hydrolyzed with fresh water, obtaining an acid layer and an oil layer, and the oil layer is subjected to a washing operation with brine, following which the brine-washed oil is treated with a strong aqueous alkaline solution to neutralize the residual acid constituents.

Figure 3 illustrates the flowsheet involved. Fresh water 12 is added to the sludge 11 and both are heated in hydrolyzer 13, from which the acid layer is drawn off as bottoms 17. The oil layer taken off through line 18 is mixed with salt water 19 in mixer 20, heated by heater 22, and settled in vessel 24 from which the salt water is withdrawn as bottoms 25, while the oil layer drawn off through line 26 is mixed with caustic 27 in mixer 28, sufficient to neutralize acid present, and then run into storage tank 30.

Patents Issued in January

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for January 3, 10, 17, 24 and 31, Vol. 630, Nos. 1-5.

Fuels

2,493,712-7 (General Aniline & Film Corp.)—Stabilized iron pentacarbonyl and motor fuel containing same.

2,494,590 (Westinghouse Electric Co.)—Liquid fuel-atomizing nozzle.

2,494,714 (Westinghouse Electric Co.)—Automatic delay action fuel valve for oil burners.

Conversions

2,492,998-9 & 035-6 (Houdry Process Corp.)—Minimizing carbon deposition.

2,493,218 (Socony-Vacuum Oil Co.)—Gas-solid contact process.

2,493,219 (Socony-Vacuum Oil Co.)—Cyclic hydrocarbon conversion.

2,493,235 (Socony-Vacuum Oil Co.)—Gas-solid contacting.

2,493,499 (Standard Oil Development Co.)—Pretreating hydrocarbons to be isomerized by hydrogenating with Pd catalyst.

2,493,672 (Socony-Vacuum Oil Co.)—Hydrocarbon conversion.

2,493,761 (Standard Oil Co.—Ohio)—Silica-free alumina-beryllium fluoride cracking catalyst.

2,493,911 (Pan American Refining Corp.)—Cycling adsorbent solids.

2,494,337 (Standard Oil Development Co.)—Contacting finely divided solid particles with gaseous materials.

Patent Trends

2,494,510 (Polymerization Process Corp.)—Polymerization of propylene in presence of isobutane.
2,494,556 (Houdry Process Corp.)—Treating clay catalysts used for conversion of sulfur-containing feeds.
2,494,595 (Standard Oil Development Co.)—Olefin polymerization in presence of fluorine compounds.
2,494,586 (Houdry Process Corp.)—Cracking hydrocarbons with modified kaolin catalyst.
2,494,695 (Sinclair Refining Co.)—Pyrolytic conversion of hydrocarbons with recovery of coke.
2,494,794 (Gulf Oil Corp.)—Catalytic cracking with pellet catalyst and regeneration.
2,495,323 (Compagnie Francaise de Raffinage)—Alkylation with methyl chloride.
2,495,648 (Shell Development Co.)—Isomerizing straight chain hydrocarbons with cracking catalyst.
2,495,709 (Koppers Co.)—Silica-alumina dehydrogenation catalyst.
2,495,751 (Houdry Process Corp.)—Conversion of hydrocarbons with modified clay catalysts.

Refining

2,493,567 (Anglo-Iranian Oil Co.)—Purifying hydrocarbons from mixtures.
2,493,881 (Phillips Petroleum Co.)—Extraction of condensible hydrocarbons from distillate well effluent.
2,494,335 (Standard Oil Development Co.)—High purity n-heptane.
2,494,371 (Standard Oil Development Co.)—Removing oxygenated organic compounds from hydrocarbons.
2,494,546 (Standard Oil Development Co.)—Separating butene-4 and butene-2.
2,495,133 (Pan American Refining Corp.)—Treating hydrocarbons with HF.
2,495,842 (Standard Oil Development Co.)—Fractionation of gases with solid adsorbents.
2,495,850 (Standard Oil Co.—Ind.)—Extracting aromatics with BF_3 complex.
2,495,851 (Standard Oil Co.—Ind.)—Desulfurizing with BF_3 complex.
2,495,852 (Standard Oil Co.—Ind.)—Decolorizing with BF_3 complex.
2,496,207 (Shell Development Co.)—Azeotropic distillation of hydrocarbons from sulfolanes.

Lubricants

2,493,213 (Socony-Vacuum Oil Co.)—Lubricant rust-inhibited with triethyl lead caproate.
2,493,216-7 (Socony-Vacuum Oil Co.)—E.P. lubricant.
2,493,483 (Shell Development Co.)—Marine engine lubricant capable of forming stable emulsions.
2,493,596 (Shell Development Co.)—Deasphalting lubricating oils with $SbCl_3$.
2,493,986 (Standard Oil Development Co.)—Heavy metal salts of alkyl phenol sulfides.
2,493,987 (Standard Oil Development Co.)—Aluminum salts of alkylated phenol sulfides.
2,494,331 (Nopco Chem. Co.)—Free-flowing aluminum stearate solution.
2,494,332 (Standard Oil Development Co.)—Extreme pressure lubricants.
2,494,341 (Standard Oil Development Co.)—Pour inhibited oil.
2,494,550 (Glidden Co.)—Refined rosin giving non-yellowing soaps by treating with selenium compound.
2,494,592 (Standard Oil Development Co.)—Treating synthetic polymers with phosphorus and sulfur.
2,495,478 (Socony-Vacuum Oil Co.)—Mineral oil containing P-S reaction product.
2,495,651 (Socony-Vacuum Oil Co.)—High temperature ball bearing grease.

Chemicals

2,492,955 (Shell Development Co.)—Polyoxalkylene compounds.
2,492,956 (Shell Development Co.)—Unsaturated hydrocarbons from unsaturated ketones.
2,492,983 (Houdry Process Corp.)—Methanol by reacting methane with sulfur trioxide and hydrolyzing.
2,492,984 (Houdry Process Corp.)—Methanol and methyl ether by hydrolyzing polyhalide.
2,492,985 (Houdry Process Corp.)—Oxidation of hydrocarbons in presence of liquid catalytic films.
2,493,038 (Houdry Process Corp.)—Reaction of methane with sulfur trioxide.
2,493,268 (Phillips Petroleum Co.)—Copolymerizing butadiene and styrene.
2,493,544 (Standard Oil Development Co.)—Stabilization of xylidine.
2,493,572 (Cities Service Oil Co.)—Dibenzylidene anhydroenneaheptitol.
2,493,781 (Standard Oil Development Co.)—Purification of alkyl phenols.

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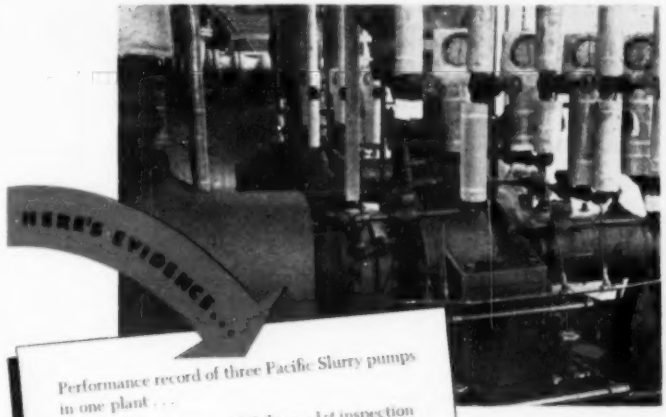

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3rd run – on stream . . 420 days
Total On Stream . . 1110 days – 2nd inspection

1st inspection made on 1 pump only. No parts were replaced as the condition of the pump was perfect.

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Write for Bulletin 86A

PR-10

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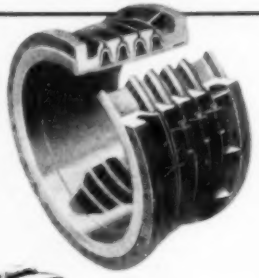

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Patent Trends

2,493,809 (Texaco Development Co.)—Polyphosphate manufacture.
2,494,274 (Sinclair Refining Co.)—Xylene recovery by extractive distillation.
2,494,515 (Shell Development Co.)—Substituted ethers of cyclic sulfones.
2,494,517 (Shell Development Co.)—Granular polymerization of vinyl chloride.
2,494,587 (Houdry Process Corp.)—Forming gaseous sulfides and sulfidation therewith.
2,494,687 (Pure Oil Co.)—Oxidizing mercaptans in presence of C-nitroso aromatic compounds.
2,494,758 (Socony-Vacuum Oil Co.)—Condensation of aldehydes with aromatics or thiophenes in presence of glauconite.
2,494,766 (Jasco, Inc.)—Milling isobutylene-multiolefin copolymer synthetic rubber prior to curing.
2,495,332 (Celanese Corp. of America)—Partial oxidation of hydrocarbons.
2,495,489 (Shell Development Co.)—N-halo derivatives of organic sulfonamides.
2,496,251 (Standard Oil Development Co.)—Secondary alcohols.
2,496,253 (Shell Development Co.)—Xylenes.

Hydrocarbon Synthesis

2,493,454 (Stanolind Oil & Gas Co.)—Gas processing for synthesis of hydrocarbons.
2,494,561 (The Texas Co.)—Combination process for hydrogenation of CO and production of ammonia.
2,494,576 (Odell)—Cyclic process for making combustible gas high in hydrogen.
2,495,292 (Du Pont)—Hydrogenation of carbon monoxide and monoolefin polymers.

Specialties

2,492,994 (Shell Development Co.)—Asphalt containing acid of phosphorus.
2,494,336 (Rohr Aircraft Corp.)—Flame, oil and gasoline-resistant sealing composition.
2,494,708 (Josseph)—Stable bituminous emulsion containing ammonium-ligno-sulfonate.
2,495,030 (Standard Oil Co.—Ind.)—Flushing oil.

Catalysts

2,492,948 (Universal Oil Products Co.)—Controlling catalyst regeneration temperature.
2,492,958 (Houdry Process Corp.)—Employing fluent catalyst.
2,493,494 (Standard Oil Development Co.)—Heat recovery in a fluidized catalyst regeneration.
2,493,526 (Standard Oil Development Co.)—Controlling temperature in fluidized catalyst regeneration process.
2,493,784 (Houdry Process Co.)—Catalyst kiln.
2,493,806 (Gulf Research & Development Co.)—Silica-alumina catalyst.
2,493,917 (Standard Oil Co.—Ind.)—Solvent extraction of contaminants on conversion catalysts.
2,494,614 (Universal Oil Products Co.)—Fluidized catalyst regeneration.
2,495,262 (Hydrocarbon Research)—Catalytic treatment and catalyst regeneration in stationary beds.
2,495,786 (Houdry Process Corp.)—Prevention of afterburning in a moving bed catalyst regeneration process.

Miscellaneous

2,493,498 (Shell Development Co.)—Furnace.
2,494,120 (Phillips Petroleum Co.)—Expansion refrigeration system.
2,494,372 (Standard Oil Development Co.)—Bubble cap construction.
2,494,525 (Martin & Schwartz, Inc.)—Positive action reel for gasoline dispensers.
2,494,628 (Universal Oil Products Co.)—Electric moisture-temperature device.
2,495,798 (Chicago Bridge & Iron Co.)—Vessel for storage of liquids at low temperatures.

How to Obtain Patents

Readers may obtain copies of U. S. patents from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

Answers to the questions presented regularly here are supplied through the co-operation of authorities with the equipment and engineering companies of the Natural Gasoline Supply Men's Assn., among others. Readers are invited to submit queries on plant problems in their own work.

Tips on Acid Descaling of Heat Transfer Equipment

What are the recommended acids and conditions in acid cleaning of boilers and the water-side of heat exchangers?

The prevention of scale formation through proper treatment of the water used is, of course, the first line of attack. However, there often is an economic limit to treating sufficiently to obtain water totally free from scale forming solids while the design of many modern boiler internals makes mechanical cleaning difficult and expensive, if not economically impractical. Acid solvents have been used to descale boilers and heat exchangers for many years. Unfortunately, there is as yet no single solvent solution or compound suitable for all types of scale.

It appears best not to use the "standard" boiler cleaning acid as freely in boiler equipment known to contain interstices capable of retaining the solution despite otherwise complete drainage, or where a porous, heavy or deep oxide such as Fe_2O_3 (magnetite or magnetic iron oxide) is firmly attached to the base metal. Neither should it be used where nonferrous metals are exposed. Ability to displace or positively neutralize solutions trapped in non-drainable parts and to flush the scale chips from these surfaces is of prime importance.

The two most commonly used acids are hydrochloric and lactic, generally 5% acid, by weight, in water. The latter has been used successfully during the past 10 years where carbonates form the greater part of the deposit or where hydrochloric acid is either not essential or undesirable, producing water, carbon dioxide and a chalky precipitate. It attacks steel slightly but has little effect on many of the other solids often found in boiler water. Release of carbon dioxide could be troublesome if it is trapped, since it is corrosive at high temperatures and the corrosion products are difficult to detect.

Hydrochloric (muriatic) acid has been used prior to 1924. Uninhibited HCl is most effective at temperatures of about 200°F., because of reduction of cleaning time. High temperatures increase chemical action, minimize entrainment of air and increases movement of the solution to assist scale detachment and removal. Fig. 1 illustrates the variation in cleaning time required at different temperatures. After 10 to 12 hours the acid solution is displaced with a solution containing 3 lbs. each of caustic soda and soda ash per 1000 lbs. of water.

Metal loss possibilities are the great concern of operators. Fig. 2 indicates the probable metal loss with hydrochloric acid under different concentrations and temperatures. The corrosion rates indicated for 5% acid

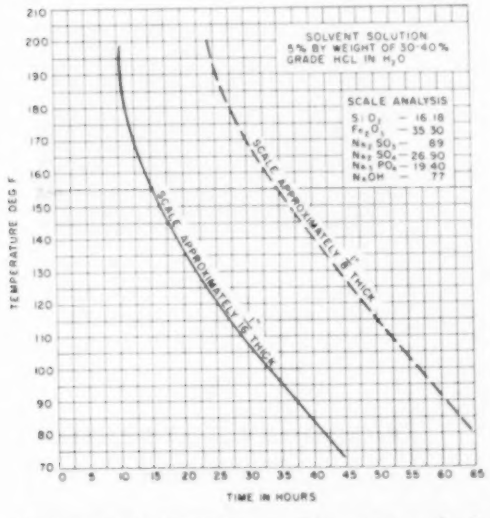

Fig. 1—Effect of temperature on 5% muriatic acid solutions in removing boiler scale, showing the reduced cleaning time required by heating the solvent

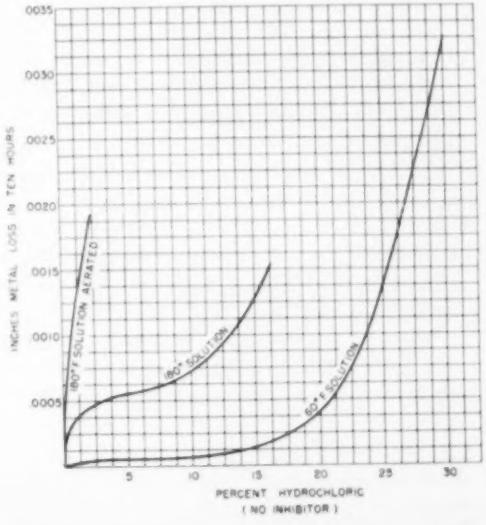

Fig. 2—Metal loss from muriatic acid solutions at various temperatures and concentrations

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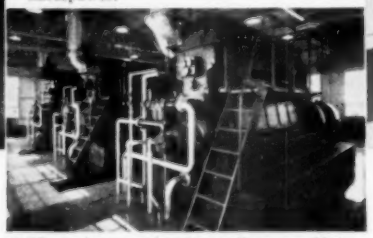
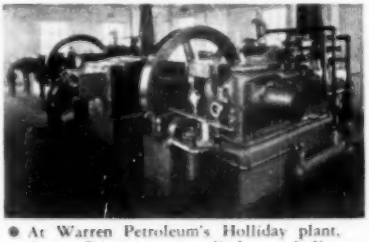
● Line-up of GMV's in Warren Petroleum's Antioch plant where these and 4 additional GMV's total 10,400 compressor horsepower.



● These three 505 hp Cooper-Bessemer JS-6 gas engines drive lean oil pumps in Warren Petroleum's Maysville plant.



● At Warren Petroleum's Holliday plant, Cooper-Bessemer 4 cylinder twin-line pumps, driven by Cooper-Bessemer 150 hp GAW gas engines, are in gasoline work, each handling up to 14,500 bbl of lean oil a day at 800 psi.

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The modern compressors, engines and pumps shown here are part of Warren Petroleum's most recently added facilities. They are now serving in various phases of the Company's gasoline work and pressure maintenance. All are Cooper-Bessemer units, built by a company likewise recognized as a leader in its field . . . *for over a century!*

When planning your power, compressing and pumping needs, be sure to check with Cooper-Bessemer on the new features, new developments that continue to uphold this kind of leadership.

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and clean steel suggests a metal loss of only 0.01 in. after 20 applications of 10 hours each.—E. R. Kilsby, Service Department, Foster-Wheeler Corp., New York.

Estimating Molecular Weight Of Absorption Oil

We wish to follow the molecular weight of our absorption oil very closely, maintaining it at 200 in winter for increased propane recovery. I understand the determination of molecular weight by the benzene freezing point depression method would be reliable, based on the distillation curve for the oil. Is it possible to use such a short-cut method for molecular weight determination?

If the gravity and A.S.T.M. or Engler distillation are known, the molecular weight of an absorbing oil may be estimated by means of the chart, Fig. 1. On this chart the molecular weight is given as a function of the average boiling point for various values of the API gravity. The average boiling point may be taken as the arithmetic average of the 10%, 30% 50%, 70%, and 90% points on the Engler distillation curve when plotted on a D plus L basis.

The chart was originally proposed by Watson and Nelson[1] and may be used with sufficient accuracy for predicting the molecular weights of petroleum fractions similar to absorbing oil. However, if the difference between the 10% and the 90% points on the Engler distillation is appreciable greater than 250-300° F. it may be advisable to use a correction suggested by Smith and Watson[2].

A comparison of molecular weights estimated by this chart with experimental values shows good agreement. —D. L. Katz and Brymer Williams, Dept. of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor.

Quick Test for Fractures In Engine Crankshafts

How can a fractured or cracked crankshaft be detected?

Fractures usually are found in the fillets of the journals, near the crank web, and are the result of a concentration of stresses at these points. These cracks seldom are visible to the naked eye in the early stages.

First step in detecting them is to clean the shaft and then wipe it free of all grease and oil. Then suspend it horizontally, using only the two end bearings for support. When it is thoroughly dry, apply a thick coat of a mixture of alcohol and powdered chalk around the journal at the fillets and allow to dry again.

The alcohol will evaporate quickly, leaving the surface covered with a thin coating of chalk. Rotate the shaft slowly several times. Location and extent of any minute fractures will be indicated by a stained line in the chalk, which results from oil working out of the crack as the shaft is rotated.—Max E. Landry, Bruce-Macbeth Engine Co., Tulsa.

References

(1) Watson and Nelson, *Ind. Eng. Chem.*, 29, 1408 (1937).

(2) Smith and Watson, *Ind. Eng. Chem.*, 25, 880 (1933).

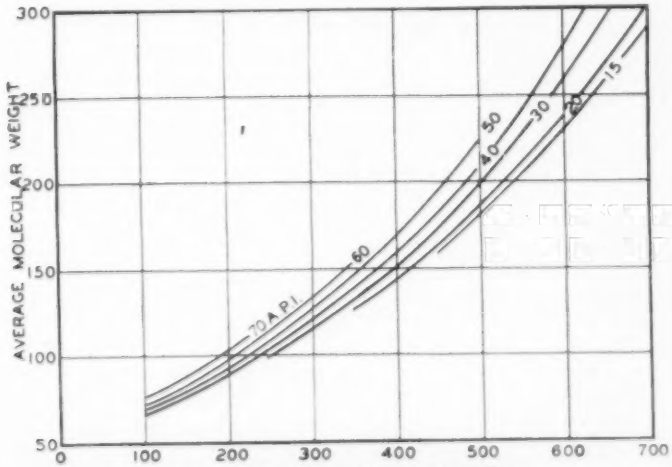

Fig. 1—Chart for estimated molecular weight of absorbing oil

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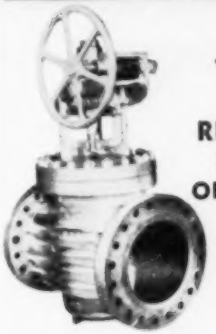

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Furnace Uses Fluidized Solids For Improved Heat Transfer

UNIFORM, CONTROLLED HEATING at relatively low temperatures—below 1000° F.—or at high temperatures can be attained in a new indirect heat exchange type furnace of novel design and approach, shown in Fig. 1.

Combustion of the fuel gas takes place within the body of an agitated, finely divided solid heat carrier, which in turn exchanges heat indirectly through conventional tubes with the material to be heated. By this method it is claimed radiation is greatly reduced and conduction is greatly increased, permitting uniformity and ease of close control.

The drawing in Fig. 1 has been simplified insofar as coils 4 are concerned. The operation is described by choosing a specific process; in this case, the dehydrogenation of methylcyclohexane to toluene with a tungsten sulfide-nickel sulfide catalyst.

For this endothermic reaction a series of tubes connected to common headers is preferred to the single tube 4. Also, since the tubes are filled substantially with a bed of catalyst pellets, they are inclined. These variations however have no bearing on the functioning or control of the heating system.

The finely divided solid may be, for example, particles of zirconia, about 100 to 500 microns in diameter. There are thirty-two 3-in. alloy reaction tubes, 24 ft. long in the combustion zone. The unit has a heat adsorption capacity of about 10 MM Btu./hr. and a thermal efficiency of about 65%, excluding the power drives for the blowers.

In starting, valve 30 is throttled, valve 31 is opened, and blower 21 is started. The amount of air circulated is adjusted by means of these valves and/or the blower so as to bring the powder 2 into the desired fluidized state. Burner 5 is started. When the temperature of the solid 2 reaches about 600° F. or somewhat higher, blower 10 is started and natural gas is introduced via perforated lines 8 and 9. The total introduction of gas into the combustion zone is regulated to give a superficial gas velocity of about 2 ft./sec. At that point the zirconia powder 2 is in an agitated fluidized state, having a density of about 30-40 lbs./cu. ft.

When the temperature in the combustion zone reaches the desired point, for instance 1200° F., burner 5 is shut off, valve 30 is adjusted, and methylcyclohexane is passed through reaction tubes 4. The temperature then is controlled by control of the natural gas and the air supplied to the combustion zone. The density and agitation of the powder may be adjusted by adjusting the amount of gas recycled. Gas which is not recycled is discharged via line 22, throttling valve 30 to the stack.

A small amount of powder collects in the cyclone separator and is reintroduced into the combustion zone via line 26. In some cases it is desirable to inject steam or water by nozzles 29; particularly when a low-temperature, highly exothermic reaction is being carried out.

The unit is intended for operation at substantially atmospheric pressure. The combustion, however, takes place under positive pressure, due to the "hydraulic" head of the powder 2 in a pseudo-liquid state. Operation under even greater positive pressures has some advantages but is inclined to increase too much the cost of the unit.

U. S. 2,493,498, issued January 3, 1950, to Norman E. Peery, assignor to Shell Development Co., San Francisco, Calif.

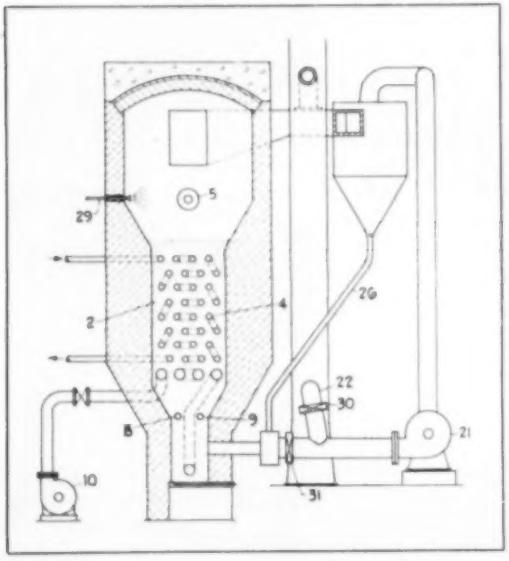


Fig. 1—Close regulation and uniform heat is said to be obtained in furnace employing a bed of fluidized solid particles 2 to provide transfer of heat from combustion gases to the coils 4 (U. S. 2,493,498)

Cracking Heater Is Designed To Handle "Tarry Materials"

SATISFACTORY CRACKING of "tarry materials," such as pressure tar and gilsonite, can be accomplished in a recently designed petroleum cracking furnace. Materials obtained from the conversion as end products include a distillate, solid fuel, and fixed gases.

The solid fuel consists essentially of amorphous carbon fused into dense, non-porous, generally rounded lumps. Any hydrocarbons withdrawn from the cracking chamber which are not of the composition of the desired end products can be recycled through the cracking chamber where they are cracked to form the desired end products.

Tarry materials are cracked by feeding them in liquid form to the top of a bed consisting of pieces of refractory material which are prevented from becoming cemented together. The bed is heated from above to maintain a temperature gradient from its top to its bottom which ranges from a point above cracking temperature to a point below the temperature at which thermal reactions occur. Hydrocarbons which are fed to the top of that bed are decomposed at the top and upper portion of the bed to form fixed gases, hydrocarbon vapors, and carbon. The fixed gases and hydrocarbon vapors are then withdrawn from the bottom of the bed.

The apparatus consists of a chamber having a cracking compartment and a quenching compartment. Those compartments are separated by a partition which is adapted to support a bed of loose pieces of refractory material, and which contains slits for the passage of hydrocarbons from one compartment to the other.

The cracking compartment has a source of heat, means for feeding hydrocarbons to the top of the bed, and means for preventing the refractory material in the bed from becoming cemented together. The

quenching compartment has means for providing a curtain of cooling liquid along the slits of the partition.

U. S. 2,495,613, issued January 24, 1950, to Malcolm H. Tuttle, New Rochelle, N. Y.

Patents Issued in December

The following classified listing covers patents issued during the month of December, 1949, believed to be of interest or value to petroleum processing and handling operations:

Catalytic Processes

2,492,998-2,492,999 (Houdry Process Corp.)—Apparatus for minimizing deposition of carbonaceous material.
2,493,635-2,493,636 (Houdry Process Corp.)—Apparatus for minimizing deposition of carbonaceous material.
2,493,219 (Socony-Vacuum Oil Co., Inc.)—Apparatus for hydrocarbon conversion.
2,493,235 (Socony-Vacuum Oil Co., Inc.)—Apparatus for gas-solid contacting.
2,493,404 (C. F. Braun & Co.)—Expansion joint for catalytic cracking unit.
2,493,672 (Socony-Vacuum Oil Co., Inc.)—Apparatus for hydrocarbon conversion.
2,493,784 (Houdry Process Corp.)—Catalyst regeneration apparatus.
2,494,337 (Std. Oil Development Co.)—Apparatus for contacting finely divided solid particles with gaseous materials.
2,494,614 (Universal Oil Products Co.)—Apparatus for fluidized catalyst regeneration.
2,495,152 (Std. Oil Co., Indiana)—Device for pressuring fluidized solids.

Processes, General

2,493,265 (Hoffman-La Roche, Inc.)—Countercurrent liquid extraction apparatus.
2,493,969 (Floyd D. James)—Heat exchanger.
2,494,372 (Std. Oil Development Co.)—Bubble cap construction.
2,494,576 (William W. Odell)—Apparatus for making combustible gas.
2,494,588 (Std. Oil Development Co.)—Extruder reactor for the low temperature polymerization of olefinic substances.
2,495,512 (Morton I. Dorfan)—Bubble tower.
2,495,613 (Malcolm H. Tuttle)—Apparatus for cracking tarry materials.
2,495,937 (Joseph P. Lawler)—Water-treating apparatus.

Heaters and Furnaces

2,493,498 (Shell Development Co.)—Heater for refining methods involving very high temperatures.
2,493,970 (Socony-Vacuum Oil Co., Inc.)—Heater for granular solids in the cracking of hydrocarbons to large yields of ethylene.
2,494,893 (Phillips Petroleum Co.)—Rotary burner with interrupted annular finned cover plate.

Pumps

2,493,197 (De Forest C. Inman)—Sliding vane pump.
2,495,601 (Rite-Way Products Co.)—Pump oiling means.
2,495,771 (Estate of Joseph R. Richer)—Isometrically cooperating vane pump.
2,495,895 (Universal Oil Products Co.)—Fluid circulating device.

Tanks

2,492,960 (Chicago Bridge & Iron Co.)—Lifter roof storage tank.
2,492,961 (Chicago Bridge & Iron Co.)—Gas holder.
2,492,963 (Chicago Bridge & Iron Co.)—Sealing means for liquid storage tanks.
2,492,601 (John H. Wiggins)—Fluid storage apparatus.
2,495,724 (Chicago Bridge & Iron Co.)—Elevated tank.
2,495,742 (Chicago Bridge & Iron Co.)—Seal support for floating roof tanks.
2,495,755 (Chicago Bridge & Iron Co.)—Seal for floating roof tanks.
2,495,798 (Chicago Bridge & Iron Co.)—Vessel for storage of liquids at low temperatures.

Tools

2,493,096 (Babcock & Wilcox Co.)—Tube expander.
2,493,528 (Ralph P. Davis)—Wrench frame mounting a pivoted inner jaw fulcrumming on a nut rotatable on threaded shank of a sliding outer jaw.
2,494,847 (Cutler-Hammer, Inc.)—Safety control for welding electrode holder.
2,495,699 (George H. Clark)—Grip tightening device for pipe wrenches.
2,495,758 (Foster Wheeler Corp.)—Welding jig.

Valves

2,495,628 (Otis T. Broyles)—Automatic safety valve assembly.
2,498,176 (George V. Powers)—Valve.
2,496,215 (Fisher Governor Co.)—Diaphragm motor for valves.

Miscellaneous

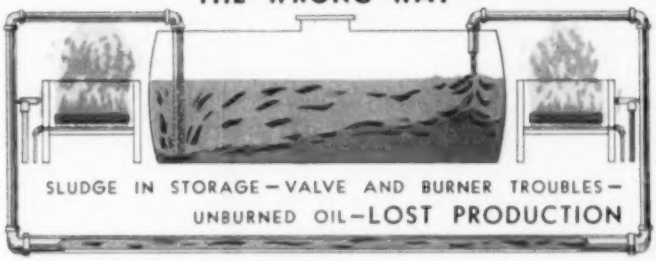
2,493,548 (William E. Proctor)—Boiler level alarm system.
2,493,966 (Daniel J. Parmesan)—Pipe union.
2,494,767 (A. O. Smith Corp.)—Removable vertical tube evaporator.
2,495,208 (Factory Mutual Research Corp.)—Fog producing spray nozzle.
2,495,416 (Claudius R. McCauley)—Liquid level indicator.
2,496,160 (Cardox Corp.)—Hand fire extinguisher.

How to Obtain Patents

Readers may obtain copies of U. S. patents from the Patent Office at 25c each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

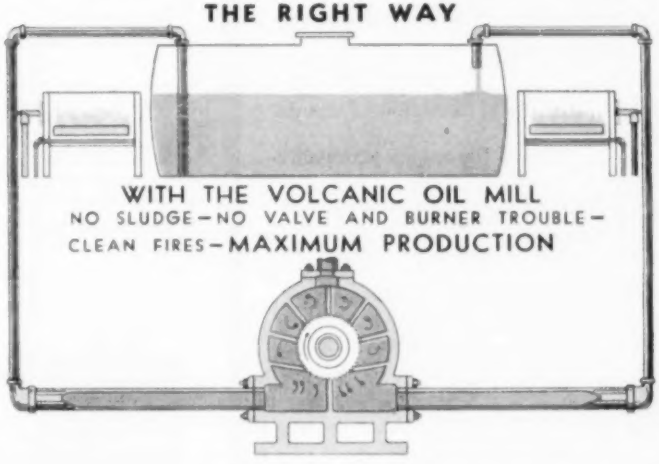
TWO WAYS OF BURNING OIL

THE WRONG WAY



SLUDGE IN STORAGE—VALVE AND BURNER TROUBLES—
UNBURNED OIL—LOST PRODUCTION

THE RIGHT WAY



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ALLIANCE, OHIO

[*To obtain more data on advertised products see page* 296]

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2216-A

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Carbonic Gas . . . Sodium Chlorite Products . . . Sodium Methylate . . . Sulphuric Acid

REFINING TRENDS

Residual Fuels Take the Impact of Coal Strike and Cold Spell

RESIDUAL fuel oil operations at refineries in February were forced out of the normal seasonal trend by both the prolonging of the coal strike and the cold spell coming late in the month. Indicated demand increased sharply in place of the normal leveling off, and stocks were materially reduced. The trend in heating oils did not respond to these two factors to as great an extent.

Residual Fuels—Indicated rate of refinery output in Feb. was about 10% under that of a year ago but imports were sufficient to bring total supply to a little larger than in Feb., '49, this being the first time in a year in which supply was above that of the corresponding previous period. Refinery production for all of 1949 was about 9% under that of 1948 and, while imports were 40% larger, total supply was about 4% under that of 1948.

Indicated Feb. demand for residuals was above that in Jan. and 11% larger than in Feb. '49. Demand for all 1949 was about 1% under 1948.

Stocks of residuals showed an indicated drop of over 8,000,000 bbls. in Feb., compared with a drop of 3,100,000 bbls. in Feb. '49 and of around 1,500,000 bbls. in Feb. '48. Stocks for the U. S., except California, were down to around 22,000,000 bbls. by March 1, as compared with 34,200,000 bbls. March 1 a year ago.

Indicated residual stocks in California March 1 were around 25,500,000 bbls., about the same as the year before. The improvement here is much greater than these figures indicate, however. Due to the extensive shipments of California heavy fuel oils to the East Coast over the past several months, stocks there have been reduced from around 40,000,000 bbls. at the end of last August. Table 1 shows the volume of heavy fuel oil stocks in various refining areas.

Heating Oils (Kerosine and Distillates)—Both indicated refinery output of heating oils and demand thus far in '50, while responding to the seasonal trend, are ahead of the first two months of '49. Rate of kerosine output is considerably larger than a year ago. This is in contrast with the trend of operations throughout 1949. For all of that year kerosine output was 16% under '48, distillate fuels nearly 11% less and total heating oils about 12% under '48. Demand for heating oils for all of '49 was around 6.7% less than for all of '48.

Indicated stocks of heating oils March 1 were around 71,000,000 bbls., kerosine stocks being somewhat less and distillate stocks a little larger than on March 1, '49. Table 2 shows the location of heating oil stocks by refining areas as of March 1 and the change from the same date of 1949.

Crude Runs—Indicated runs of domestic crude in Feb. were slightly under Jan. and around 4% less than in Feb., '49. Average indicated total crude runs for the first two months, around 5,408,000 b/d, are slightly under the forecast crude runs for the first quarter of 5,450,000 b/d. The Bureau of Mines forecast of crude runs for March, 5,350,000 b/d, is just under indicated actual runs in Feb.

Motor Fuels—Indicated rate of production for the first two months of 1950 is about 2.5% higher than for 1949, while the supply of motor fuel for all of 1949 was 4.3% larger than in 1948. The total volume of gasoline produced from crude in 1949 was about 4% larger than the year before, while the total of natural gas liquids used in motor fuels was nearly 6% greater.

Gasoline stocks (finished and unfinished) reached an indicated total of around 135,000,000 bbls. March 1, compared with 126,054,000 bbls. the same date in 1949. However, the buildup in stocks from Sept. 30, '49 is 33,250,000 bbls., compared with a buildup of 35,500,000 bbls. the same period the preceding year.

Fig. 1, Runs to Stills—3% Under Feb. '49

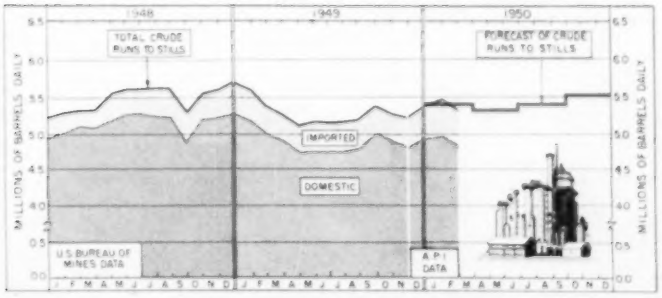

1948
1949
1950
TOTAL CRUDE RUNS TO STILLS
FORECAST OF CRUDE RUNS TO STILLS
IMPORTED
DOMESTIC
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Table 1—Location of Residual Fuel Oil Stocks March 1, '50

(1000 Bbls.)

Area	March 1* 1949	March 1** 1950	% Change
East Coast	11,432	9,121	−20.2
Gulf Coast	12,340	7,090	−42.6
Inland			
Appal.	316	350	+10.8
Ind.-Ill.-Ky.	4,911	2,670	−46.1
Northwest	3,379	1,675	−50.4
Rocky Mts.	785	525	−33.1
Total Inland	9,931	5,220	−47.2
California	25,176	25,490	+1.2
Total U. S.	58,588	47,421	−20.2

* Bureau of Mines Data.
** Indicated from API Data.

Table 2—Location of Heating Oil Stocks, (Kerosine and Distillates) March 1, '50

(1000 Bbls.)

Area	March 1* 1949	March 1** 1950	% Change
East Coast	28,169	26,150	−10.0
Gulf Coast	16,695	16,000	−4.2
Inland			
Appal.	1,224	1,200	−21.2
Ind.-Ill.-Ky.	10,742	8,700	−9.7
Northwest	6,125	5,300	−19.5
Rocky Mts.	1,261	1,200	+14.4
Total Inland	19,850	17,700	−10.9
California	7,161	11,100	+54.9
Total U. S.	72,800	70,900	−2.7

* Bureau of Mines Data.
** Indicated from API Data.

Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Feb. '50 API*	4,878	447	5,325
Feb. '49 BM	5,091	389	5,480
Change	−213	+58	−155
% Change	−4.2	+14.9	−2.9

*Through Feb. 25th.

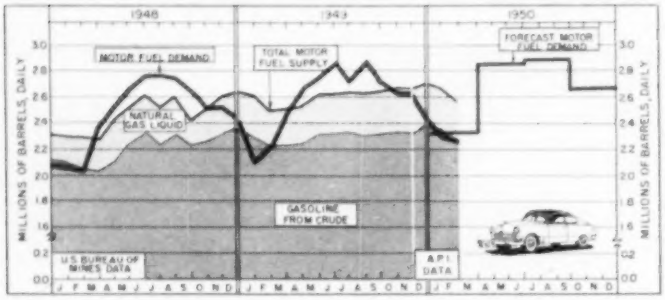
Total (1,000,000 bbls.)
(Bureau of Mines Data)

12 Mo. '49	1,790.6	154.5	1,945.1
12 Mo. '48	1,916.6	124.0	2,040.6
Change	−126.0	+30.5	−95.5
% Change	−6.1	+24.6	−4.2

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
Feb. '50 API	42.0	6.3	18.6	21.7
Jan. '50 API	41.0	7.0	19.4	21.5
Dec. '49 BM	43.4	5.2	18.6	21.3
Feb. '49 BM	41.6	5.8	19.5	23.5

Fig. 2, Motor Fuel—Output at About 1949 Rate


1948
1949
1950
MOTOR FUEL DEMAND
TOTAL MOTOR FUEL SUPPLY
FORECAST MOTOR FUEL DEMAND
NATURAL GAS LIQUID
GASOLINE FROM CRUDE
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Natural Gas Liquids include natural gasoline blended at refineries, and used direct as motor fuel.

Fig. 3, Gasoline Stocks—Reach 135,000,000 Bbls.

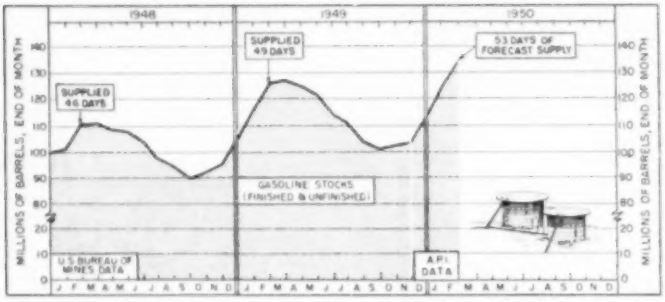

1948
1949
1950
SUPPLIED 46 DAYS
SUPPLIED 49 DAYS
53 DAYS OF FORECAST SUPPLY
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Fig. 4, Heating Oils—Seasonal Drop in Demand

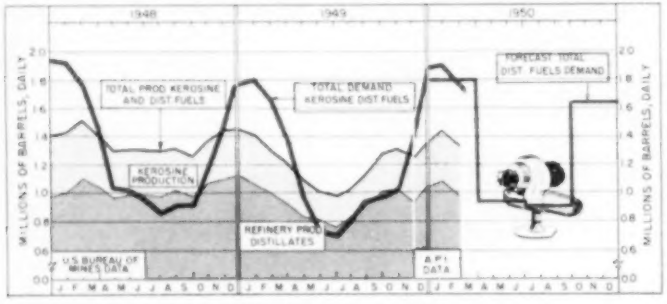
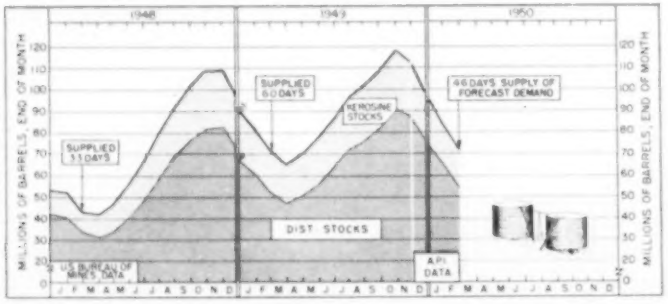

1948
1949
1950
TOTAL PROD KEROSINE AND DIST FUELS
TOTAL DEMAND KEROSINE DIST FUELS
FORECAST TOTAL DIST. FUELS DEMAND
KEROSINE PRODUCTION
REFINERY PROD DISTILLATES
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Fig. 5, Heating Oil Stocks—Below Feb. 28, '49


1948
1949
1950
SUPPLIED 33 DAYS
SUPPLIED 60 DAYS
46 DAYS SUPPLY OF FORECAST DEMAND
KEROSINE STOCKS
DIST. STOCKS
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

* Change in reporting in California eliminated 4,500,000 bbls. from distillate classification.

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Feb. '50 API*	2,280	305	2,585
Feb. '49 BM	2,253	290	2,543
Change	+27	+15	+42
% Change	1.2	5.2	1.7

*Through Feb. 25th.

Total (1,000,000 bbls.)
(Bureau of Mines Data)

12 Mo. '49	833.6	108.2	941.8
12 Mo. '48	819.7	102.2	921.9
Change	+33.9	+6.0	+39.9
% Change	4.1	5.9	4.3

Motor Fuel Demand Including Exports

Daily Average (1000 bbls.)

Feb. '50 API*	2,200
Feb. '49 BM	2,200
Change	+60
% Change	4.7

* Through Feb. 25th.

Total (Bbls.)
(Bureau of Mines Data)

12 Mo. '49	972,356,000
12 Mo. '48	968,572,000
Change	+43,784,000
% Change	4.8

Gasoline Stocks

(Bbls., finished and unfinished, end of month)

Feb. '50 API	135,000,000
Jan. '50 API	123,626,000
Dec. '49 BM	111,421,000
Feb. '49 BM	126,654,000

Heating Oils Production Kerosine and Distillates

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuel	TOTAL
Feb. '50 API*	248	968	1,216
Feb. '49 BM	214	1,004	1,218
Change	+32	−15	+17
% Change	15.2	1.4	1.3

*Through Feb. 25th.

Total (1,000,000 bbls.)
(Bureau of Mines Data)

12 Mo. '49	102.1	339.5	441.6
12 Mo. '48	121.9	380.7	502.6
Change	−19.8	−41.2	−61.0
% Change	16.2	10.8	12.1

Heating Oils Demand

Daily Average (100 bbls.)

	Kerosine	Dist. Fuel	TOTAL
Feb. '50 API*	429	1,561	1,790
Feb. '49 BM	295	1,291	1,687
Change	+23	+79	+103
% Change	8.1	5.4	6.1

*Through Feb. 25th.

Total (1,000,000 bbls.)
(Bureau of Mines Data)

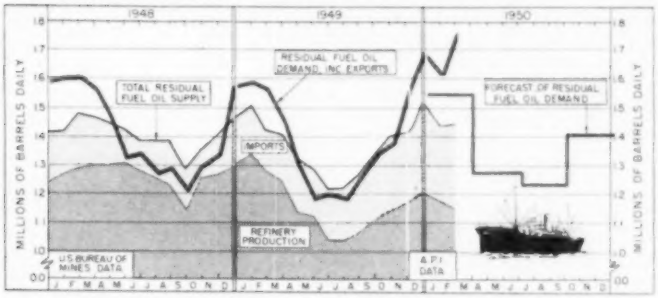
12 Mo. '49	105.1	340.2	445.3
12 Mo. '48	115.7	361.9	477.6
Change	−10.6	−21.7	−32.3
% Change	9.1	6.0	6.7

Heating Oil Stocks

(1,000,000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTALS
Feb. '50 API	16.6	55.0	71.6
Jan. '50 API	18.1	65.5	83.6
Dec. '49 BM	20.9	75.2	96.1
Feb. '49 BM	18.9	53.9	72.8

Fig. 6, Residuals—Sharp Spurt in Demand



Residual Fuels Production

Daily Average (1000 bbls.)

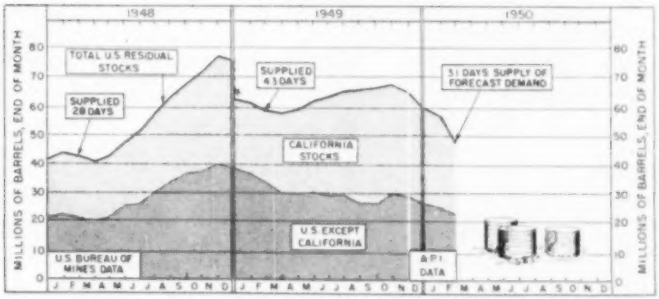
		Refinery Output	Imports	TOTAL
Feb. '50	API*	1,338	200	1,453
Feb. '49	BM	1,282	153	1,435
Change		+126	+142	+18
% Change		9.7	92.8	1.2

* Through Feb. 25th.

Total (1,000,000 bbls.)
(Bureau of Mines Data)

12 Mo.	'49	424.8	74.5	499.3
12 Mo.	'48	466.3	53.2	519.5
Change		−41.5	+21.3	−20.2
% Change		8.9	40.0	3.9

Fig. 7, "Resid" Stocks—20% Under Year Ago



* Change in reporting in California eliminated 13,000,000 bbls. from residual classification

Residual Fuels Demand

Daily Average (1000 bbls.)

Feb. '50	API*	1,516
Feb. '49	BM	1,568
Change		−178
% Change		11.9

* Through Feb. 25th.

Total Demand (bbls.)

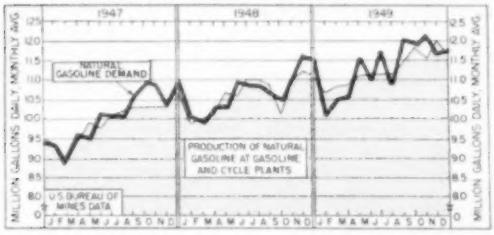
12 Mo.	'49	597,902,000
12 Mo.	'48	603,294,000
Change		−5,392,000
% Change		0.9

Residual Fuel Stocks

(Bbls. end of Month)

		U.S. Except California	TOTAL U.S.
Feb. '50	API	22,150,000	47,500,000
Jan. '50	API	23,700,000	55,986,000
Dec. '49	BM	20,200,000	60,193,000
Feb. '49	BM	24,222,000	59,398,000

Fig. 8, Production and Demand of Natural Gas Liquids


1947
1948
1949
MILLION GALLONS DAILY, MONTHLY AVG
NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

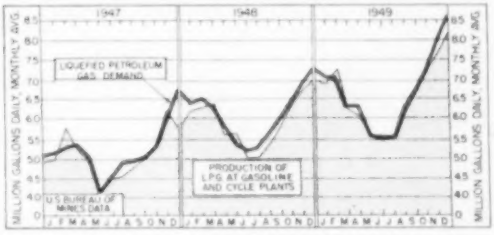
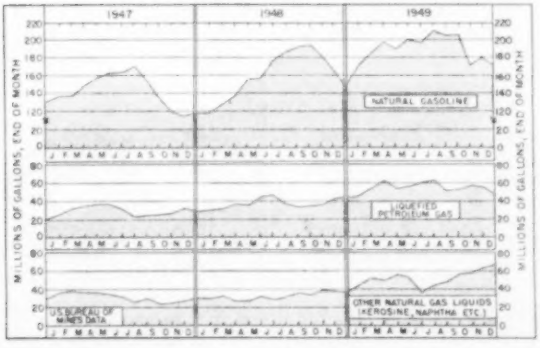

1947
1948
1949
MILLION GALLONS DAILY, MONTHLY AVG
LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF LPG AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Fig. 9, Stocks of Natural Gas Liquids


1947
1948
1949
MILLIONS OF GALLONS, END OF MONTH
NATURAL GASOLINE
LIQUEFIED PETROLEUM GAS
OTHER NATURAL GAS LIQUIDS (KEROSINE, NAPHTHA ETC.)
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Natural Gas Liquid Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

		Production (1000 gal/day avg.) Natural Gasoline	LPG**	TOTAL	Demand* (1000 gal/day avg.) Natural Gasoline	LPG	TOTAL
Dec.	'49	11,790	8,130	19,920	13,774	8,550	20,324
Dec.	'48	11,233	7,307	18,220	11,590	7,214	18,804
Change		+.497	+1.183	+1.670	+.184	+1.336	+1.520
% Change		4.3	16.9	9.2	1.6	18.5	8.1

		Total Production (1000 gal)			Total Demand (1000 gal)		
12 Mo.	'49	4,142,110	2,418,838	6,560,948	4,168,793	2,433,596	6,602,389
12 Mo.	'48	3,953,216	2,209,071	6,162,287	3,966,162	2,247,531	6,214,294
Change		+188,894	+209,767	+398,661	+202,631	+186,065	+388,095
% Change		4.8	9.5	6.5	5.1	8.3	6.2

Stocks, End of Month (gal)

		By Type of Product— Natural Gasoline	LPG	Other Products†	By Location— Refineries	Gasoline Plant	TOTAL
Dec.	'49	172,207	49,229	65,493	81,228	205,600	286,828
Nov.	'49	180,927	57,349	61,158	86,572	213,579	299,851
Dec.	'48	151,571	44,147	58,614	64,286	149,946	214,232

* Demand, including exports but not transfers, is supplied from receipts from outside sources as well as current production and stock changes. Outside receipts totaled 17,351,000 gals. in December.

** Does not include LPG produced at refineries which in December totaled 87,216,000 gals.

† Includes kerosine, naphtha, specialty and other products.

HOW TO SELECT A DESALTING PROCESS

Refiners with a salt problem should get satisfactory answers to these three questions before selecting a salt removal process

1 *Does it provide high-efficiency removal?*

PETRECO DESALTING is providing high efficiency salt removal for refiners everywhere. A recent survey of 42 Petreco Desalting plant installations disclosed an average removal percentage of 93.6%. This high percentage salt removal was variously credited in the refineries surveyed with an average days-on-stream increase of 204% in the topping and combination units, 136% in the cracking and combination units; a decrease in corrosion damage of 75%; a betterment of 8% in the Service Factor and an average increase in exchanger utility of 190 days (before fouling). *High efficiency salt removal assures more efficient refining — Petreco can show you recorded proof.*

2 *Is there an adequate service organization?*

PETRECO DESALTING is backed by a service organization with unparalleled know-how in the field of electric desalting. Petreco maintains resident desalting engineers close to every Petreco installation. Petreco desalting supervisors are located in all major refining areas. Petreco stocks of replacement parts are always convenient and available for emergency repairs. Petreco engineers not only design your desalter into your flow stream and supervise its construction, they regularly inspect the desalter to assure safety, proper maintenance and high-efficiency performance.

3 *Is it a tested and proved process?*

PETRECO pioneered electric desalting. With Petreco Desalting you get the most complete and authoritative assembly of electric desalting know-how extant. The Petreco research staff has been studying desalting problems for years, Petreco design engineers have been engaged exclusively in the design and construction of desalting plants, and Petreco service engineers and supervisors have been dealing with salt problems in refineries throughout the industry since the inception of Petreco Desalting. No other desalting process can assure you of more experienced personnel or provide comparable case histories of successful use.

Petreco engineers are always available to give you the facts on the economies of high-efficiency Petreco Desalting, write or call

PETROLEUM RECTIFYING COMPANY

5121 South Wayside Drive, Houston 1, Texas
648 Edison Building, Toledo 4, Ohio
530 West Sixth Street, Los Angeles 14, Calif.

PETRECO

SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PR 50-4

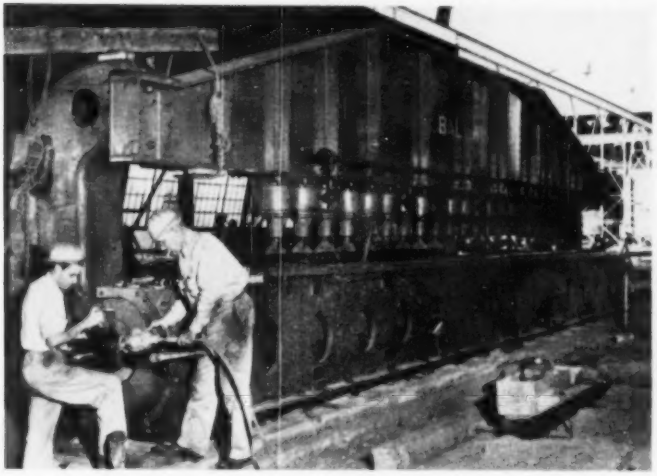
[To obtain more data on advertised products see page 296]

NEWS OF

Manufacturers—Suppliers—Engineering Firms

Serving the Petroleum Processing Industry

U. S. Steel Subsidiary Inaugurates Operations in New Orange, Texas, Plant



New edge planer being installed in Consolidated Western Steel's new Orange, Texas, pipe mill

Consolidated Western Steel Corp., a United States Steel subsidiary, is anticipating full operation by mid-March in its new Texas plant at Orange. The steel plate fabricating shop is scheduled for full operation by March 1, and the pipe mill about March 15. The Orange wartime shipyard, adjacent the present plant, is now under conversion to additional fabricating facilities.

The output of the Orange plant will be principally for the Gulf Coast's petroleum and chemical processing industries—towers, tanks, pressure vessels, heat exchangers, and the like. The pipe mill will produce 24-in. and larger, electric welded and expanded steel pipe. First production will be 31-ft. lengths of 30-in. pipe. The mill is geared for 50 miles of pipe a month when it reaches full production.

Slide-rule Vacuum Calculator

F. J. Stokes Machine Co., 5900 Tabor Rd., Philadelphia 20, Pa., has recently issued a slide-rule type vacuum calculator. It will help determine 1) the needed pump capacity to evacuate a given volume to a specified vacuum in a given time, 2) the time required to evacuate a given volume to a specified vacuum with existing pumps, 3) vapor pressure of water at various temperatures, 4) boiling points of solvents under vacuum, and 5) capacity of round tanks in cu. ft./ft. and gals./ft. for specific diameters. The Stokes Vacuum Calculator is available at 50c each from the company. Remittance must accompany the request.

Equilibrium and Fugacity Charts

Two large volumes of charts containing liquid-vapor equilibrium constants, and one large volume containing fugacities for light hydrocarbons in mixtures, have just been published by M. W. Kellogg Co., Jersey City, N. J.

Differing from similar charts issued in the past, these graphs are not only functions of temperature and pressure but also of the composition of both liquid and vapor phases. The charts cover pressures graduated from atmospheric to 1000 psia. for any mixture from methane to n-heptane, including unsaturates. For higher pressures, Kellogg has made available fugacity charts that go from 1000 to 3600 psia.

Instructions for use and sample calculations for bubble points, dew points, and equilibrium flash points are included. The two volumes covering pressures from 14.7 to 1000 psia. are available as a package for $20. An additional $10 will be charged for the volume of fugacity charts.

For copies, write Chemical Engrg. Div., M. W. Kellogg Co., 225 Broadway, New York 7, N. Y.

Rockwell Increases Tulsa Facilities

Rockwell Mfg. Co. has moved the main part of its instrument manufacturing facilities from Pittsburgh to its Macnick Division in Tulsa, Okla. Products involved are the orifice meter, Integrator, and related parts. Company officials state the move was in keeping with the policy to have products manufactured as close to the market as possible wherever practical.

Theisinger to Lukens Houston Post

Dr. Theisinger

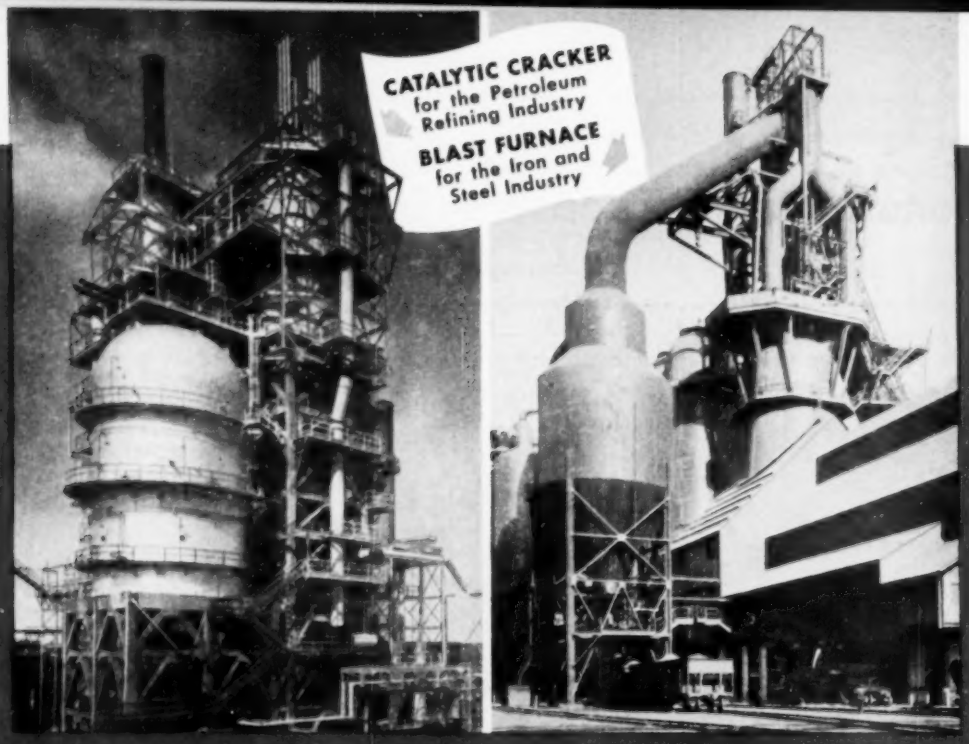
William G. Theisinger has been appointed regional manager of sales for Lukens Steel Co., with headquarters in Houston. Dr. Theisinger has been manager of technical sales at the main office in Coatesville, Pa., for the last four years. In his new position, he will supervise sales activities in 12 southern states.

He joined Lukens in 1935, becoming director of welding research in 1941. A native of Carlisle, Pa., he was graduated from Harvard University from which he received the degree of Doctor of Science.

Panapak Licensing Agent Appointed

Pan American Refining Corp. has appointed Marshall-Moorman Development Co., of New York City technical and licensing agents for "Panapak," a new industrial packing for fractionating towers, it has been announced.

The packing is said to provide a twofold increase in capacity compared with bubble caps, together with a considerable increase in efficiency. A honeycomb-like assembly of mul-



McKEE BUILDS *Processing Machines* FOR BOTH OF THESE INDUSTRIES

WHAT OIL MEN AND STEEL MEN WILL TELL YOU ABOUT McKEE ENGINEERING:

They'll tell you McKee engineering is *thorough*—that McKee builds sound, practical production facilities for *both* industries.

McKee's knowledge and experience in oil and steel prove advantageous to McKee clients in each industry and has solved problems in other fields.

McKee service is prompt and construction rapid. That means lower costs and earlier completion of a profit producing plant.

Wherever iron and steel are produced or oil is refined, successfully operating McKee-built plants prove "*McKee Engineering means assured results*".

● It may be any type of refinery from a crude distillation unit to a catalytic cracker . . . a blast furnace, open hearth or ore beneficiation plant, but in each case *the plant is the machine.*

McKee builds these multi-million-dollar "plant-machines" for two of the world's basic industries—Petroleum Refining and Iron and Steel.

Where successful operation and profitable investment depend so much on the plant itself, plant design must be *correct*—engineering *thorough*—and construction *sound.* That's why oil men and steel men all over the world call on McKee for all types of production facilities.

ARTHUR G. McKEE & COMPANY

DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

ENGINEERS AND CONTRACTORS • ESTABLISHED 1905
2300 CHESTER AVENUE, CLEVELAND
30 Rockefeller Plaza, New York, N. Y.

tiple layers of expanded metal lath, Panapak can be used for all fractionation and distillation problems, and it is expected will also find application in liquid-to-liquid extraction, humidifiers, etc. It has been in use almost two years in a commercial installation at Pan American's Texas City refinery.

Flaschar Named President Stacey Gas

Mr. Flaschar

Eric A. Flaschar has been elected president of Stacey Bros. Gas Construction Co., Cincinnati. He has been general manager of Stacey-Dresser Engrg. Div. of Stacey Bros., which is currently in the process of being moved from Cleveland to Cincinnati. Mr. Flaschar's background has been chiefly in the petroleum field. His first work in this country following his technical education in Austria and Germany was with Standard Oil of California, where he was chief design engineer before joining M. W. Kellogg.

In 1943, Mr. Flaschar became executive vice president of Hydrocarbon Research, Inc., and in 1945 he joined the Dresser Industries, Inc.

Fluor Starts Engineering Building

As part of the expansion program at the 27-acre main plant in Los Angeles, Fluor Corp. has started work on a new engineering building. The two-story, air-conditioned structure will have 9200 sq. ft. of floor space, including a full basement, and will be built of pre-cast reinforced concrete.

Fluor personnel directly connected with construction plans include George W. Meyer, manager of lands and buildings, as coordinator, and Fred Hopkins, project manager.

Personnel Changes

Johns-Manville Industrial Products Division—T. J. Roberts has been appointed Houston district manager, supervising sales in Texas, parts of Louisiana, Arkansas, and Oklahoma.

Nooter Corp.—Arthur Schwarz, with the firm since 1935, has been named vice president in charge of sales.

Blaw-Knox Co.—L. W. Alberts now is manager of the recently organized synthetic fuels and chemicals department of the Chemical Plants Division. A pioneer in Fischer-Tropsch work in Germany and director of Ruhrchemie since 1929, Mr. Alberts joined Blaw-Knox early in 1949, following two years at the Bureau of Mines station Bruceton, Pa.

Monsanto Chemical Co.—James B. Irwin, Jr., has been made a member of the petroleum chemical sales department of the Organic Chemicals Division.

Minneapolis-Honeywell Regulator Co.—K. R. Knoblauch has been appointed manager of sales of valve products for the industrial division. He has been with the **Brown Instruments** division since 1924 in engineering and sales work. He will continue to headquarter at the Brown Philadelphia plant offices.

Peabody Engrg. Corp.—Pelton W. Ellis has been named manager of the refining equipment division, and Stephen A. Sloan now is manager of research and development.

Tube Turns Inc. has moved its Tulsa office from 317 South Detroit Ave. to 420 Wright Bldg. Telephone number, 2-9193, remains the same.

LUBREX 45

has ideal melting point for greases and harder soaps

LUBREX 45

TITRE.... (111.2-114.8°F) 44.0-46.0°C

Color 5¼" Lovibond Column (max.)	35 Yellow — 8 Red	
Iodine Value (Wijs)	25 —	35
Free Fatty Acid (as oleic)	100 —	104%
Acid Number	199 —	206
Saponification Value	202 —	209

HARDESTY FATTY ACIDS

RED OIL • GLYCERINE • STEARIC ACID • WHITE OLEINE • HYDROGENATED FATTY ACIDS • STEARINE PITCH • ANIMAL & VEGETABLE FATTY ACIDS • PALMITIC ACID

Lubrex 45, a product of Hardesty research, fits the demand for a polyunsaturate-free fatty acid especially designed for soap and lubricating grease manufacture. The fatty acids in Lubrex 45 are stabilized in our new hydrogenation unit, to give them a greater resistance to heat discoloration. Freedom from polyunsaturated fatty acids prevents rancidity or gum formation from excess unsaturation. No highly unsaturated acids remain to act as agents for polymerization. The melting point of Lubrex 45 has been accurately controlled to give the optimum possible degree of hardness for your precise requirements. Color and uniformity are strictly maintained. Write for details.

W. C. HARDESTY CO., INC.

HARDESTY PRODUCTS ARE INDUSTRY'S KEYSTONE

Established 1926

41 EAST 42nd STREET, NEW YORK 17, N. Y.

Factories: Dover, Ohio
Los Angeles, Calif. • Toronto, Can.

[To obtain more data on advertised products see page 296]

ADVERTISERS' INDEX

(Each advertiser listed below has been assigned a code letter for the reader's use in securing additional information about an advertised product or service. This code letter appears in parenthesis to the left of the advertiser's name.)

(A) ALLIED CHEMICAL & DYE CORP. Inside Back Cover
Atherton & Currier, Inc.

(B) ALUMINUM CO. OF AMERICA 239
Ketchum, MacLeod & Grove

(C) ALUMINUM CO. OF AMERICA 277
Fuller & Smith & Ross, Inc.

(D) AMERICAN DISTRICT STEAM CO. 280
Squier & Davis, Inc.

(E) ARCO CO., THE 275
Lamb, Fisher & Blashower, Inc.

(F) BADGER, E. B. & SONS CO. 236, 237
Harold Cabot & Co., Inc.

(G) BADGER MFG. CO. 282
Tippett, Jackson & Nolan, Inc.

(A) BAKER & ADAMSON Inside Back Cover
Atherton & Currier, Inc.

(H) BONNEY FORGE & TOOL WORKS 305
Scherbarth, Inc.

(I) BROWN FINTUBE CO. 238
Henry T. Bourne Adv. Agcy.

(J) BUFFALO TANK CORP. 306

(K) CAREY, PHILIP MFG. CO. 307
Farson-Huff & Northlich

(L) CHEMICAL CONSTRUCTION, THE 214
Michel-Cather Inc.

(M) CHICAGO BRIDGE & IRON CO. 210
Russell T. Gray, Inc.

(N) CHIKSAN CO. 303
Eng F. Irvin

(O) COCHRANE CORP. 306
Willard G. Myers Adv. Agcy.

(P) COOPER-BESSEMER CORP. 284
Griswold-Eshleman Co.

(Q) CRANE CO., THE 225
The Buchen Co.

(R) DIETERT, HARRY W. CO. 304

(S) DuPONT de NEMOURS & CO., INC. E. I. 217
Charles L. Rumrill & Co., Inc.

(T) DuPONT de NEMOURS & CO., INC. E. I. Facing Page 240
Charles L. Rumrill & Co., Inc.

(U) ETHYL CORP. 209
Batten, Barton, Durstine & Osborn, Inc.

(1A-7A) FLUOR CORP., LTD. 278
Dozier-Graham-Eastman

(V) FOSTER WHEELER CORP. Facing Page 224
Albert Frank - Guenther Law Inc.

(W) FOXBORO CO., THE 233
Hutton-Noyes Co.

(X) GENERAL AMERICAN TRANSPORTATION CORP. 212, 213
Weiss & Geller

(A) GENERAL CHEMICAL DIVISION Inside Back Cover
Atherton & Currier, Inc.

(Y) GIRDLER CORP. 235
The Griswold-Eshleman Co.

(Z) GLIDDEN CO., THE 311
Meldrum & Fewsmith, Inc.

(AA) GRAVER TANK & MFG. CO., INC. 230
Almon Brooks Wilder, Inc.

(AB) GRINNELL CO., INC. 231
Hutton-Noyes Co.

(AC) HARDESTY, W. C. CO. 295
The House of J. Hayden Twiss

(AD) HARTZELL PROPELLER FAN CO. 232
The Right Adv. Co.

(AE) HOPKINS VOLCANIC SPECIALTIES 287

(AF) HUDSON ENGINEERING CORP. Inside Front Cover
Elves Dyke & Co.

(AG) KELLOGG CO., THE M. W. Facing Page 272
Gordon Baird Assoc., Inc.

(AH) KELLOGG CO., THE M. W. 218
Gordon Baird Assoc., Inc.

(AI) MATHIESON CHEMICAL CORP. 288
Doyle, Kitchen & McCormick, Inc.

(AJ) MONSANTO CHEMICAL CO. 221
Gardner Advertising Co.

(AK) McKEE & CO., ARTHUR G. 294
Macmanus, Inc.

(AL) NATIONAL AIROIL BURNER CO. 224
E. E. Loeskin Corp.

(AM) NATURAL GASOLINE SUPPLY MEN'S ASSOCIATION 240

(AN) NORDSTROM VALVE DIVISION 222, 223
The McCarty Co.

(AO) OAKITE PRODUCTS, INC. 309
Richard A. Foley, Inc.

(AP) PACIFIC PUMPS 281
The McCarty Co.

(AQ) PETRO-CHEM DEVELOPMENT CO. 308
Sam J. Gallay Co.

(AR) PETROLEUM RECTIFYING CO. 292
Brickman & Fellows Adv.

(AS) POWELL CO., WM. 234
Advertisers' Agency, Inc.

(AT) PRECISION SCIENTIFIC CO. 300
Critchfield & Co.

(AU) ROOTS-CONNERSVILLE BLOWER CORP. 298
Fuller & Smith & Ross, Inc.

(AV) TAYLOR FORGE & PIPE WORKS 301
Krecker & Meloan Inc.

(AW) UNIVERSAL OIL PRODUCTS CO. 226, 227
Almon Brooks Wilder, Inc.

(AX) UNIVERSAL OIL PRODUCTS CO. 285
Almon Brooks Wilder, Inc.

(AY) UP-RIGHT SCAFFOLDS 299
Norton M. Jacobs Adv. Agcy.

(AZ) VAPOR RECOVERY SYSTEMS CO. 302
The McCarty Co.

(BA) WEDGEPLUG VALVE CO., INC. 285
Stone-Stevens, Inc.

(BB) WESTERN SUPPLY CO. 229
White Advertising Agcy.

(BC) WYATT METAL & BOILER WORKS Outside Back Cover
Wallace Davis & Co.

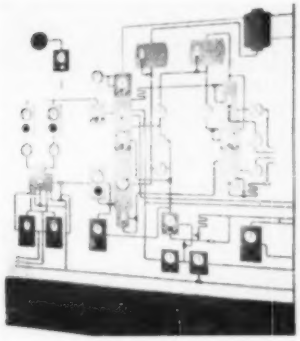
(The italic lines below name of the advertiser identify company's advertising agency)

What's New!

EQUIPMENT . . . MATERIALS . . . PROCESSES . . . LITERATURE

Reviewed by WILLIAM C. UHL, Equipment Editor

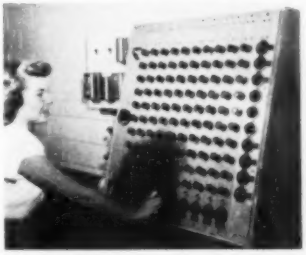
Two New Graphic Instrument Panels Effect Substantial Space Savings



The Brown "Grafic" and "Color-Grafic" instrument control panel boards, soon to be made available to the refining industry, represent the latest entry into this rapidly growing field of automatic and simplified instrumentation for petroleum and chemical processing plants. The panel design, developed in cooperation with a leading refinery contracting engineering firm and the Henry Dreyfuss organization of industrial designers, involves an efficient use of color, arrangement, and symbols. In general it follows the concepts of other recently announced graphic panels, employing the small size gages and remote setting controllers. The standard "Grafic" panel (shown in the photograph) incorporates all instruments within the flow diagram. In the Color-Grafic, fuller use of color is made and all controllers are mounted below rather than on the flow diagram. In this way a sizable reduction in board length is attained. A color and symbol code ties in the controllers with the various points in the process. Comparative reduction in board length, it is stated, is about as follows: from 45 ft. in the conventional panel to 19 ft. with the Color-Grafic, and 24 ft. 4 in., in the Grafic. Brown Instrument Co.

Check No. **1** *on Reply Card*

Spectro Computer Solves up to Ten Equations in 5 to 30 Minutes



The "Phillips 66 Spectro Computer," an electrical calculating device which will solve simultaneous linear equations of the type encountered in infrared and mass spectrometry, is now being made available. The computer, which utilizes D.C. electrical potentials substituted for the unknowns in the equations, solves these equations by a method of iteration. Multiplication, division, addition, and subtraction steps necessary in solving a spectroscopic analysis problem involving as many as ten simultaneous equations can normally be performed by the device within 5 to 30 minutes. Results of spectroscopic analysis of hydrocarbon samples have been computed to an accuracy of 0.1%. Phillips Petroleum Co., Special Products Div.

Check No. **2** *on Reply Card*

Open Air Process Plants Can Use New Splash-proof Electric Motor

An outdoor splash-proof motor for use in open-air process plants, outdoor steam generating stations and the like has been announced. Built in sizes from 150 to 2000 hp., 4 to 14 poles, this addition to the Elliott "Fabri-Steel" motor line can withstand severe weather conditions such as hurricanes, salt fogs, sand and snow storms, it is said. Foreign matter blown into the ventilating openings is deflected by baffles and either drains out or travels straight through the exterior ventilating system without entering the interior of the motor itself. Screens or filters may be added in the inlet hoods. The foundation may be a simple concrete slab. A pedestal with cored openings or other special construction is not necessary. Elliott Co.

Check No. **3** *on Reply Card*

Obtain Efficient Caustic Regeneration By Filter Press-type Electrolytic Unit

Regeneration of caustic employed in sulfur removal operations in the refinery can be done electrolytically by a new process which is still in the patent pending stage. The process, it is said, will overcome problems in existing caustic regenerators; for example, the return regenerated caustic stream may contain up to 70% of the mercaptans, and the hydrogen sulfide getting by the preliminary scrubber may be so high as to require discarding the caustic every month. Operation of the electrolytic

For More Information

Use one of the attached reply cards to request additional information or literature on any items reviewed in "What's New!" Just check the numbers corresponding to the numbers on the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage required.

TWO NEW R-C BULLETINS

for smaller volume, moderate pressure applications

If you are handling gas or air for any of the purposes listed below, or for similar applications, you need these two new bulletins on R-C Rotary Positive AF Blowers and XA Gas Pumps.

1. Air for combustion with oil or gas burners, small cupolas, coke-fired forges, etc., in:

- Iron and steel works
- Food processing industries
- Neon sign shops
- Chemical processes
- Nonferrous foundries
- Asphalt heaters
- Smelters
- Oil-fired forges
- Bakeries
- Ceramic, brick and tile mills

2. Aerating and agitating liquids, in:

- Ice plants
- Sewage and industrial waste disposal
- Electroplating, engraving and electrotyping
- Fish tanks or trucks, also shallow lakes
- Oyster washing
- Water treatment
- Protecting dams from ice
- Fruit, vegetable and poultry washing and cooling
- Blending vinegar, fruit juices, etc.
- Compounding oils

3. Miscellaneous pressure or suction uses:

- Pneumatic conveying of grains, insulation and liquids
- Rock dusting in mines
- Dust collecting systems
- Low pressure sandblast
- Respirators and safety helmets
- Testing rubber balloons, etc.
- Cleaning forging dies, motors and machines
- Boosting inlet pressure of compressors
- Drying barrels and drums
- Blowing cake off filters
- Air seal for bearings of rock crushers, etc.
- Pneumatically controlled valves
- Steam garment presses
- Printing presses
- Paper folding machines
- Vacuum chucks
- Drying yarns, textiles, etc.

4. Gas Pumps for:

- Boosting fuel supply to industrial furnaces
- Chemical processes and refineries
- Boosting pressure from small gas wells
- Neon sign shops
- Gas sampling equipment
- Inert gas generators
- Exhausting oil vapors
- CO_2 collectors
- Boosting supply to gas engines

These bulletins bring you up to date on construction, capacities, regulation, control and other details on R-C Type AF Blowers (Bulletin 21-B-37) and Type XA Gas Pumps (Bulletin 31-B-17). Send for them or write us about your needs, for engineering analysis, without obligation.

ROOTS-CONNERSVILLE BLOWER CORPORATION
503 Texas Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

What's New!

procedure follows: Spent caustic from the gasoline scrubber is passed through a filter press-type electrolyzer, the alternate plates of which are charged by direct current. The plates are separated by insulating diaphragm plates. The flow through the thus-formed cells is adjusted so that no excess oxygen is liberated. The hydrogen liberated at the cathode plates is either collected in a reservoir or allowed to pass through with the caustic and collected at a separating tank into which the electrolyzed caustic stream is passed. In the separator, the insolubles, mostly disulfides, are drawn off from the upper phase and the regenerated caustic is recycled to the scrubber. Semi-plant tests with a small commercial electrolyzer have shown the power consumption is about 0.6 lbs. sulfur (mercaptan and hydrogen sulfide) removed per kwh. at ambient temperature, it is stated. No steam is required and a 36-in. electrolyzer of 60 plates is sufficient to handle the caustic from a medium-sized refining operation. American Development Co.

Check No. 4 on Reply Card

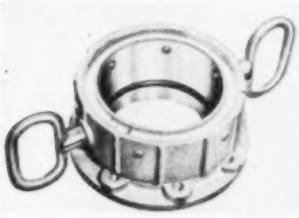
Variable-area Flow Meters Can Handle Laboratory, Pilot or Full Scale Flows

A new line of easy to read direct reading gas flow meters of variable-area type for laboratory, pilot plant or full-scale use has been developed. Several types are available as standard: table or horizontal pipe line mounting, panel mounting, angle pipe line mounting, and panel mounting with integral control valve (illustarted in a liters/min. nitrogen meter). Meters may be used with air or non-corrosive gases. Two new "Bantam" models are available; one for a flow range of 0.05 to 0.7 liters/min. oxygen, the other for 10 to 100 cc./mm. carbon dioxide. The Bantam gages are designed to replace liquid bubblers in such work as purging line metering furnace atmosphere control, inert gas carrier systems, liquid level and specific gravity measurements. Hoke, Inc.

Check No. 5 on Reply Card

What's New!

Quick Coupling in Six-inch Size Useful For Refinery or Tank Car Transfers

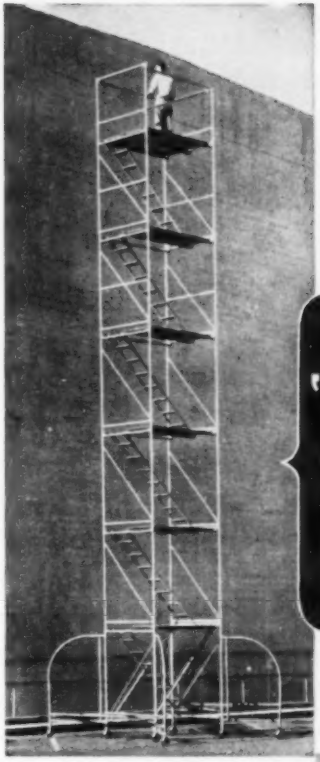


Suggested applications for the new Roylyn 1700 Series, quick disconnect coupling in a 6-in. pipe size, include refinery and tank car transfer, tank car loading and unloading, bulk chemicals handling, and marine fueling. Rated at 150 psi., the coupling measures 7 in. between flanges, and weighs 17½ lbs., assuring compactness and portability. A turn of 40° will make or break the coupling. Locking is effected with ⅝-in. stainless steel balls. Seal ring is an O-ring of synthetic rubber and is easily replaceable. The body is provided with a standard 6-in. commercial pipe flange. The mating nipple is available with either flanged or threaded end. The coupling has ring handles for winch use, as well as provision for safety chain attachment. Roylyn, Inc.

Check No. 6 on Reply Card

Tester Designed for Bearing Greases For Spring Shackles, King Pins, etc.

An oscillating grease tester, developed by Fafnir Bearing Co. and Precision Scientific Co., will test lubricants to be used for anti-friction bearings undergoing small angle vibratory movements. Manufacturers of grease, makers of chemical additives, and users of grease should find a ready application for this new apparatus, it is said. The tester was designed to evaluate the lubricating properties of greases used on automobile spring shackles, king pins, air frame control bearings, rocker



"75% SAVED on TANK and OVERHEAD MAINTENANCE"

Reports Superintendent G—

WITH *Revolutionary* NEW

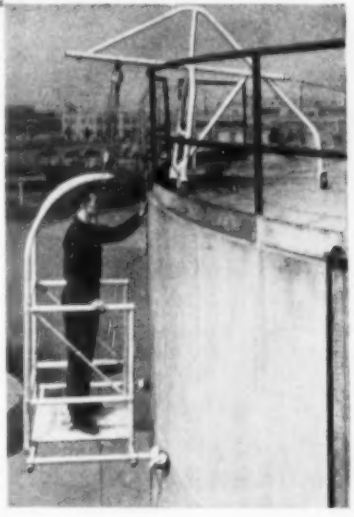
Aluminum Alloy

"UP-RIGHT" SCAFFOLDS

and

ROLL-AROUND SAFETY CAGE

Mobile 45' unit takes only 15 minutes to erect!



Scores of petroleum industry users report big labor savings on tank painting, inspection, control, gaging and general overhead maintenance with Up-Right Scaffolds and Roll-Around Safety Cage.

Scaffolds are available in desired number of 6-foot and shorter section units for rapid, easy assembly. Roll easily from position to position throughout job. Stronger than structural steel yet one third the weight. Safety tread stairway completely within structure. No wrenches, wing nuts, bolts, loose parts. Each section folds flat.

Roll-Around Safety Cage, anchored to eye-bolt on top of tank, provides a new, faster method for covering entire wall areas of tanks. Weighs only 70 lbs., and its unique design permits the use of pole guns and bulky maintenance equipment. Unusual safety features include widely spaced legs which eliminate wind hazards.

Write for detailed information

UP-RIGHT SCAFFOLDS

Dept. 137 • 1013 Pardee Street • Berkeley, Calif.

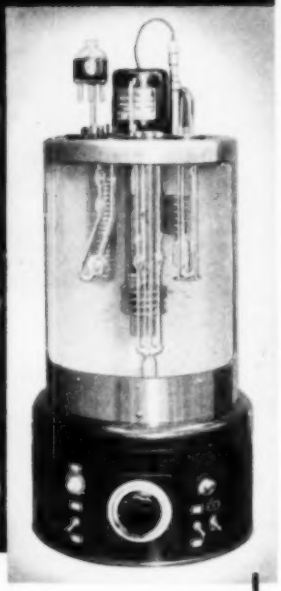
Factories: Berkeley, Calif., and Teterboro, N. J. Offices in all Principal Cities.

Count your advantages with
*PRECISION Model-S
6 Tube KINEMATIC VISCOSITY BATH
A.S.T.M.-D445 A.A.F.-3608

1. More accurate Temperature Control. Within 0.025 between 70° and 212°F. (cooling coil for lower ranges)

2. Faster, More Evenly Spread Heat. 2 immersion heaters, continuous-duty tubular stirrer

3. Easier Cleaning, Complete Visibility. Stirrer and motor lift as one; interior fluorescent light



AND this popular instrument offers further convenience. Just 1 cord line. All wiring and controls are grouped at bottom on removable panel. For 115 volts 50-60 cycles; also available for 230 volts. Notably low priced!

Order from your dealer NOW . . . or write us for Bulletin 7-705

Precision Scientific Company

*The FINEST Research & Production Control Apparatus
3737 W. Cortland Street, Chicago 47
OFFICES IN NEW YORK • PHILADELPHIA • SAN FRANCISCO

specify PRECISION, to be sure

What's New!

arms, variable pitch propellers, etc. In operation, the test grease is applied to a simple lever which exerts thrust through a calibrated spring. An electric motor is started to oscillate the test bearings through an angle of 12°, at a rate of 3450 reversals per minute under a thrust load of 550 lbs. The test is run continuously for 50 hours before the bearings are weighed and washed again. The test is comparative and the loss of weight in milligrams indicates the suitability of the lubricant. The ½ hp. motor operates on 115 v., 60 cycles. Overall dimensions of the tester are 18 in. wide, 12 in. deep, and 12 in. high. Precision Scientific Co.

Check No. **7** *on Reply Card*

Manual Polarograph Follows Design And Construction of Recorder Models

The Sargent Model III "Polarograph" is a new manually operated model incorporating the same design and construction used in Sargent's recording models, XII and XXI. It is particularly recommended for such applications to which it is peculiarly suited and in which recording is unnecessary. This includes: 1) routine analyses where only one substance is to be determined and where the step shape approximates a pure form, characteristic of reversible reactions involving simple ions in fairly substantial concentrations; 2) in laboratories where a recording instrument is now in use for several determinations; 3) in amperometric titrations; 4) for instructional purposes. Specifications follow: Galvanometer sensitivity, approximately 0.006 microamps./mm.; galvanometer shunt ratios, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, and 1000:1; voltmeter accuracy, 1% of full scale; compensator ranges—upscale, 1 x full scale, downscale, 9 x full scale; bridge voltage span selection, continuously variable from 0 to 3 volts; power consumption, less than 5 watts. E. H. Sargent & Co.

Check No. **8** *on Reply Card*

WeldELLS®

The WeldELL line is a quality line in the fullest sense of the word. It is the expression of all that has been learned in a half century of continuous research and practical experience by an organization that has consistently shown the way in forging technique and closely-controlled metallurgy as related to piping design.

The quality line—the job-speeding, cost-cutting line—is also the *broadest* line. It includes practically every type of fitting, in every weight, every size and every material needed in pipe welding. Large stocks are carried in all industrial centers.

Mail coupon for new catalog covering WeldELLS and other Taylor Forge Welding Fittings.

TAYLOR FORGE

Taylor Spiral Pipe is again promptly available in a broader range of sizes and thicknesses. Coupon brings pipe bulletin.

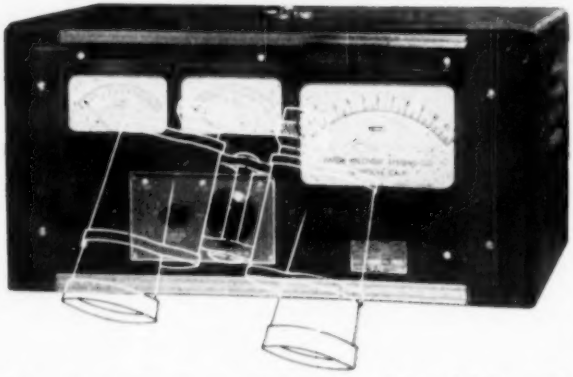
TAYLOR FORGE & PIPE WORKS
P. O. Box 485, Chicago 90, Illinois
Offices in all principal cities: *Eastern Plant:* Carnegie, Pa. *Western Plant:* Fontana, Calif.

☐ Please send new Catalog 484 covering welding fittings and forged steel flanges.
☐ Send new Bulletin 493 covering Taylor Spiral Pipe and related fittings.

NAME _____
POSITION _____
COMPANY _____
STREET ADDRESS _____
CITY _____ ZONE _____ STATE _____

715-0350 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

EYES
that see 5 MILES AWAY!



Accurate Remote Reading Liquid Levels with the "VAREC" Electronic Gauger

No magic, but "VAREC"'s application of the science of electronics to the problem of tank gauging is now giving users the utmost in safety, convenience and accuracy in obtaining liquid levels at a distance from their tanks.

The "VAREC" Electronic Gauger Receiver illustrated is the multi-tank *explosion-proof* model on which you can gauge any one of ten tanks by a twist of your fingers. Another model is available for twenty-four tanks. Power is on only at the tank being gauged. Behind the front panel, all electrical components and wiring are enclosed in an explosion-proof housing. Wire count to the tanks is less than that of any other remote gauging system and wire size is smaller due to the low current used.

Investigate this "VAREC" Electronic Gauger for your own gauging problem. Write today for a copy of "Remote Gauging at its Best!" and call in a "VAREC" Representative.

"Varec" PROVED — APPROVED

FEATURES

SAFE . . . No climbing slippery tanks during wet or icy weather—eliminates toxic gas hazard for personnel. Explosion-proof Receiver (illustrated) designed in accordance with standards for industrial control equipment as used in hazardous areas. Transmitter's electrical section completely isolated from tank vapors. Built to meet requirements of explosion-proof equipment.

ACCURATE . . . Accuracy is only limited by type of float gauge used. Measures liquid level ±1/16th inch with "VAREC" 233 Series Automatic Tank Gauges.

ECONOMICAL . . . Low initial cost; low installation cost; low maintenance cost. Pays for itself in man hours saved.

EASY TO USE . . . No waiting to take readings—you need only select the tank for a momentary or continuous accurate gauge reading. Instruments do not require resetting after power shutdown.

TROUBLE FREE MAINTENANCE . . . Designed to operate many years without service. Electronic elements function at 1/2 to 1/3 rated capacities. Plug-in parts easily replaceable.

INSTALLATION AND SERVICE POLICY . . . Engineering supervision of installation is available. Annual or biennial factory routine service check offered at nominal charge.

CP-17

THE VAPOR RECOVERY SYSTEMS CO.
COMPTON, CALIFORNIA, U. S. A.
Cable Address: VAREC COMPTON USA (All Codes)
New York • Boston • Pittsburgh • Chicago • Detroit • St. Louis • Houston
Tulsa • Casper, Wyo. • Provo, Utah • Los Angeles • San Francisco • Seattle

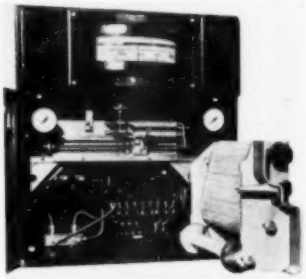
What's New!

Two-way FM Radio Pack Set Has Nominal Range of Two to Five Miles

The Motorola Pack Set, an FM 2-way radio, incorporates a 16-tube receiver and an 8-tube transmitter into a compact 19-lb. station, 10½ x 13 x 4⅞ in., that can be hand carried, back carried, or used as a semi-fixed installation. It is designed for operation in either the 25-50 megacycle or the 152-174 mc. band. Five standard 67½ volt "B" batteries and two "F" size 1½ volt "A" batteries ordinarily give five 8-hr. days of normal operation (10% transmit, 10% receive, and 80% standby.) The unit operates from pack set to pack set with a nominal range of two to five miles, with greater ranges depending on relative antenna height and physical obstructions. Motorola, Inc.

Check No. **9** *on Reply Card*

Recording Controller Combines Air And Electronic Operation for Safety

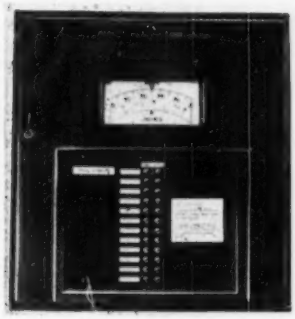


The Wheelco "Pneumatic Capacilog" is a complete air-operated control system in combination with an air-operated strip chart recorder. It is said to be ideal for applications where electric contactors or motors would create a hazard, or where fixed position changes in the regulated medium or fuel supply may be injurious to the work in process. Measurements may be obtained with any type of primary element producing an electric impulse. Temperature, speed, flow, pressure, static strain loads, voltage, amperage, etc. can be metered. Control function is performed by air—via the "Wheelco Electronic Link"—operating diaphragm motors. Four positions of the air switch provide automatic, manual, service, and off points. Proportional band knob permits settings from 5 to 150% of total scale range. Reset knob is calibrated from 0.2 to 50 minutes, providing wide selectivity. Wheelco Instruments Co.

Check No. **10** *on Reply Card*

What's New!

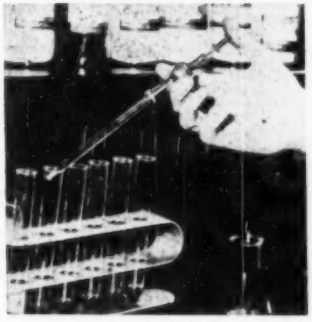
Electronic Tank Gager Is Adaptable For Use with Standard Selsyn Units



The new Shand & Jurs Electronic Precision Remote Reading Tank Gauge System will supplement the S & J Selsyn Remote Reading Tank Gauge System. The unit incorporates a Brown Instrument Co. "Continuous Balance Electronik" Precision Indicator, which utilizes the balanced Wheatstone Bridge principle in conjunction with potentiometers. The system uses 110 v. A. C. source, reduced to 6.3 v. for the measuring circuit. This low voltage permits the use of small gauge wire. Only four leads are required for each tank, and no field relays or junction boxes are needed, because each transmitter is directly connected to the receiver. Shand & Jurs Co.

Check No. **11** *on Reply Card*

High Speed and Accuracy Assured With Two New Automatic Pipettes



Liquids used as a routine in small quantities can be dispensed safely, accurately, and conveniently by means of either of two new pipettes. The "Automatic Pipette" will dispense any volume up to 2.0 ml. by operating a plunger. Once the volume selector has been set, an operator can operate the pipette 20 to 30 times

SAFE-all the Way
It's safer...and less expensive ...to insure safety *all* the way in your loading and unloading lines. With CHIKSAN *Ball-Bearing* Swivel Joints, you get the same strength...the same safety ...the same protection throughout your entire piping system because you can build your own flexible loading and unloading lines with pipe and fittings of the same strength and long life as you design and build into all other parts of your piping system. You eliminate all weak links! You eliminate all the variable hazards which increase with age and usage in all types of fabric or flexible metal hose.
Play safe *all the way!* Use CHIKSAN *Ball-Bearing* Swivel Joints to make up your loading and unloading lines. With them, you get unlimited flexibility with the strength, long life and safety of steel. You get greater protection...greater safety ...and greater economy with CHIKSAN.
CHIKSAN'S Engineering Department will gladly assist you in designing flexible lines to suit your individual needs. This Service is based on 25 years of experience in designing and developing Ball-Bearing Swivel Joints for every purpose.
CHIKSAN
TRADE MARK REG.
REPRESENTATIVES IN PRINCIPAL CITIES
CHIKSAN COMPANY
AND SUBSIDIARY COMPANIES
Chicago 3 · BREA, CALIFORNIA · New York 7
WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
CHIKSAN EXPORT CO. BREA, CALIFORNIA · NEW YORK 7
BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

[*To obtain more data on advertised products see page* 296]

SULFUR and CARBON
Analyses
in
PETROLEUM PRODUCTS

The sulfur content of oils, waxes and greases is an important measure of the value and quality of the product.

Whether the desired sulfur content be high or low, it is necessary to know exactly what amount is present.

The combustion method offers a rapid and sure means of determining sulfur in the wide range of percentages and materials encountered in the oil and grease field.

The Dietert-Detroit Sulfur Determinator embodies the correct principles of the combustion method in a simple, rugged and convenient form. Complete analysis can be made in less than five minutes.

Carbon determinations on organic compounds are being made in as little as two minutes with the Dietert-Detroit No. 3005 Carbon Determinator.

This method can be applied to any petroleum product. One example of the usefulness of this method is the analysis of cracking catalyst for carbon content.

Leading oil companies* are taking advantage of these versatile, time-saving determinators. Write to Dept. P-3 for detailed information on how you can apply rapid carbon and sulfur analysis to your problems.

*Two typical users— THE SHELL OIL COMPANY, THE PURE OIL COMPANY

CONTROL EQUIPMENT
HARRY W. DIETERT COMPANY
9330 ROSELAWN • DETROIT 4, MICH.

What's New!

per minute. It has four slots and a vernier control whereby the stroke of the plunger is set to deliver an exact volume. The plunger is actuated by a rubber bulb, and its stroke is uniform. The second model is a "Micropipette" for volumes up to 0.7 ml. It has a sliding sleeve and setscrew arrangement by means of which any pre-set volume can be expelled. Fisher Scientific Co.

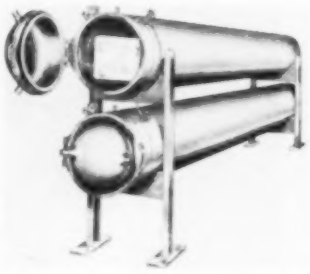
Check No. **12** *on Reply Card*

Line of Mechanical Rotary Shaft Seals Built to Fit Specific Pump Needs

A mechanical rotary shaft seal bearing the trade name "Repsco" is soon to be made available. It was designed to overcome fluid leakage on centrifugal or rotary shafts, and is fabricated to fit any pump without costly alterations. It compensates for both end thrust and misalignment in the pump, and is hydraulically actuated and balanced by fluid pressure within the pump. Each seal is designed for the specific pump and service. Republic Supply Co.

Check No. **13** *on Reply Card*

Dry Ice Conversion Units Eliminate Needs for Carbon Dioxide Cylinders



The "Full-Opening" Dry Ice Converter is useful for industrial processes that need a substantial standing supply of carbon dioxide which is readily available but which requires no attention in storage. Full 50-lb. commercial blocks of dry ice can be charged into the converter, eliminating handling of the usual CO_2 cylinders. Converters are supplied in capacities of 300, 600, 750, and 1000 lbs. dry ice. The 1000-lb. unit stores approximately 8700 cu. ft. of carbon dioxide, which can be withdrawn at rates up to 850 to 950 cu. ft./hr. Liquid carbon dioxide may also be withdrawn if desired. Converters are built to ASME code specifications. Ice Converter Corp.

Check No. **14** *on Reply Card*

Here's the easy way to get all the answers quickly . . .

If you desire more complete information on any of the products, materials or services advertised in Petroleum Processing or described in its "What's New" section, we can help you get it quickly and easily.

All the advertisements and "What's New" items appearing in this issue have been assigned key numbers. The advertisement key numbers appear in the Advertiser Index; each "What's New" item carries a code number in its headline.

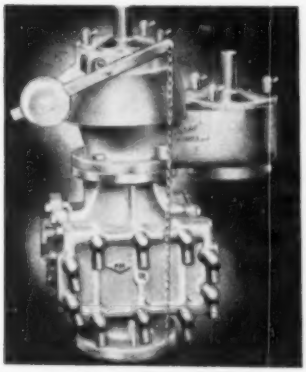
To secure additional information about either an advertised product or a "What's New" item, merely circle its key number on the READER INFORMATION SERVICE card you will find in this issue. Then, fill in your name and other pertinent mailing data requested.

Mail the card today. No postage is required.

Petroleum Processing's Reader Service Department will follow-through promptly to get immediate action for you.

What's New!

Vent Valve Capacity Tests Higher Than Open Nipple of the Same Size



The new "Varec" Vent Valve, Fig. No. 5800 Series, is said to offer the highest possible protection for venting flammable liquid storage at the lowest cost per thousand cubic feet of venting capacity. Tests have shown that the vent valve portion of the Unit, Fig. No. 2000, actually flows more than an open nipple of the same size. The valve is designed with a venturi inlet, hyperbolic pallets, center and side pallet guiding, and regrindable and renewable seats. The flame arrester portion is listed by Underwriters' Laboratories for use on oil storage tanks and approved by Associated Factories Mutuals Laboratories for chemical storage. Normally made of aluminum, it may be obtained in special materials for specific corrosion problems. Sizes range from 2 to 12 in. Vapor Recovery Systems.

Check No. 15 *on Reply Card*

Trade Literature

Cast Iron That Bends

Inco Magazine, Winter Ed., 1950, Vol. 23, No. 4: contains an illustrated article describing the new ductile iron, entitled "A New Cast Iron That Bends", a high carbon ferrous metal containing graphite in the form of spheroids, and which is said to bridge the gap between ordinary gray iron and cast steel. International Nickel.

Check No. 16 *on Reply Card*

Pump with Bladeless Impeller

The New Fairbanks-Morse Bladeless Sewage and Trash Pump, Bulletin 5400K-1, full description, dimensions, specifications, selection tables, and performance data on vertical and horizontal shaft, single pass, centrifugal pumps with bladeless impel-

WeldOlets, Butt Welding — Available as standard, with outlet sizes from ⅛" to 24", both straight and reducing for use with Schedule 40 pipe up to 12" outlet. Outlet sizes 12" - 24" for standard weight pipe (⅜" wall). Also available for Schedule 80 services through 8" outlet and extra strong through 24" outlet size (for use with pipe having ½" wall).

With WeldOlet branch pipe welding fittings you provide the quickest, most economical, most satisfactory method of obtaining full pipe strength at branch connections.

Note in the above illustration how the WeldOlet tapers to provide a single bevel groove joint at the crotch section and blends into a V-butt joint at the ear portion.

WeldOlets need no additional reinforcement to establish and fully maintain original strength on ASTM A-106 Seamless Steel Grade A Pipe, as set forth in Code for Pressure Piping, American Standards Association, B31.1-1942, and Supp. No. 2, B31.1-b-1947.

To meet special conditions, these fittings can be furnished in any forgeable metal including wrought iron, toncan iron, nickel, Monel, Everdur, stainless grades 304, 316, 347, etc.

For detailed engineering reference data, write for Catalog W-2.

BONNEY FORGE & TOOL WORKS

Forged Fittings Division, 368 Green Street, Allentown, Pa.

Authorized Canadian Factory Representative:

Sterling Steel Co., Ltd. 267 Davenport Road
Toronto, Canada

WELDOLETS

FOR WELDED BRANCH PIPE OUTLETS

WeldOlets, Socket Welding — Available as standard, with outlet sizes ⅛" - 10", both straight and reducing, for use with Schedule 40 pipe. Also available in Schedules 80 and 160 up through 4" outlet size.

ThredOlets — Available as standard, with outlet sizes ⅛ - 10", both straight and reducing, for use with Schedule 40 pipe. Also available in Schedule 80 up through 2" outlet size.

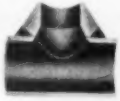


Fig. 1 — Cut-away view of reducing size WeldOlet with welding outlet in place. The external rib and wide bases or footings of WeldOlets eliminate the need for extra supports to take care of bending or vibrational stresses at crotch section, the point of greatest stress.

Fig. 2 — Note blending of ear portion of welding fitting to run pipe. Extension of weld metal below inside scarfed portion of pipe insures all sections of joint greater than pipe wall thickness.

[*To obtain more data on advertised products see page* 296]

Buffalo TANKS

Serving the
Petroleum and
Process Industries

OIL AND GAS TANKS
PRESSURE VESSELS
WELDED STEEL PLATE
CONSTRUCTION

BUFFALO TANK
CORPORATION
General Sales Office
744 Broad St., Newark 2, N. J.

PLANTS
Buffalo, N. Y.
Baltimore, Md.
Dunellen, N. J.

lers, capable of handling all kinds of solids-containing liquids without clogging or need for screens. Fairbanks, Morse & Co.

Check No. 17 *on Reply Card*

High Temperature Steels

Steels for Elevated Temperature Service, 87-page book, illustrated, with complete engineering and technical details on ferrous alloys used in all high temperature applications such as petroleum and chemical processing, power, transportation, and jet, rocket, and turbine engines. United States Steel Corp.

Check No. 18 *on Reply Card*

Describes 31 Refining Processes

Petroleum Horizons, an 80-page book giving a step-by-step description and flow sheets for 31 refinery processes, plus details on the background, organization, and service facilities of the Lummus Co.

Check No. 19 *on Reply Card*

Tube Cleaners

Lagonda Tube Cleaners, Bulletin Y-29; a 28-page booklet covering applications of air, steam, or electric-driven tube cleaners and accessory parts, including motors, cutter heads, drills, brushes, operating hose, and couplings, with hints on care and operation. Elliott Co., Lagonda Div.

Check No. 20 *on Reply Card*

Anti-Corrosion Paints

Atlas Protective Coatings, Bulletin 7-1; information on paints suitable for protection against corrosive fumes or splash on steel, concrete, and wood surfaces, including specific application, undercoats, primers, etc. Atlas Mineral Products Co.

Check No. 21 *on Reply Card*

Refractory Materials

Laclede-Keystone Pennsylvania First Quality Dry Press Fire Brick, a six-page folder giving specifications, properties and uses of this product as well as a series of cements, plastics, castables, and coatings. Laclede-Christy Co.

Check No. 22 *on Reply Card*

Continuous Sulfur Analyzer

The New Consolidated Titrilog, Bulletin 1810A; describes an automatic, continuous recording instrument for trace quantities of sulfur compounds in natural gas, and other gas mixtures; including specifications and rental service information. Consolidated Engrg. Corp.

Check No. 23 *on Reply Card*

Specific Gravity Controllers

Pycnorator Instruments, Catalog 76; 12-page bulletin covering a new line of instruments for measuring and controlling fluid density and specific gravity, including such designs as submerged float, open bubblers, closed diaphragm, and hydrometer types. Fischer & Porter Co.

Check No. 24 *on Reply Card*

Gas Compression Data

Compressibility Charts and Their Application to Problems Involving Pressure-Volume-Energy Relation for Real Gases, Bulletin P-7637; a Worthington Research Bulletin. Worthington Pump and Machinery Corp.

Check No. 25 *on Reply Card*

Lube and Fuel Filters

Sun Engrg. Co., Catalog 150: 20 pages of catalog information on a line of filters for lubricating oils and Diesel fuels; for use on pump engines, compressor drivers, and mobile engines—trucks, tractors, etc.—including specific recommendations for all leading Diesel and other internal combustion engines. Sun Engrg. Co.

Check No. 26 *on Reply Card*

Chemical Manufacturer Saves $3300 a year

Before installation of the Cochrane C-B System of Condensate Drainage Control, flashing of condensate being returned to the boiler from scattered asphalt and flux tanks caused a Chicago chemical manufacturing company to keep feed water make-up at about 55%. Condensate is now returned to the boiler by a Cochrane C-B System at 85 p.s.i. (327° F.) with a reduction of 20% in make-up. Resulting boiler efficiencies, lower maintenance and steam costs have saved the company $3300 annually.

C-B Systems in every process industry are registering similar savings for owners. By returning condensate to boilers at high temperature and high pressure, and eliminating entrained air from jackets, coils, and piping, the C-B saves valuable heat units—keeps process equipment at consistent high temperatures. Steam costs are reduced. Higher temperatures boost production. Cochrane Publication 3250 gives complete information on the C-B System. Write for your copy today. COCHRANE CORPORATION, 3134 N. 17th Street, Philadelphia 34, Pa.

In Canada: Canadian General Electric Company Ltd., Toronto

COCHRANE
C-B SYSTEM OF CONDENSATE DRAINAGE CONTROL

Absorber, Purifiers, Dew Point, And Cooling Tower Data

A series of technical papers and articles by Fluor Corp. research and engineering personnel: "Cooling Tower Maintenance," by James DeFlon,

Check No. **27** *on Reply Card*

"Evaluating Cooling Tower Performance," by James DeFlon,

Check No. **28** *on Reply Card*

"Fractionating Absorbers in the Petroleum Industry," by J. C. Hannah,

Check No. **29** *on Reply Card*

"Purification and Dehydration of Gases," by C. L. Blohm and W. F. Chapin,

Check No. **30** *on Reply Card*

"A Critical Analysis of Methods of Determination of Water Dew Point in Hydrocarbon Gases," by F. C. Riesenfeld and H. D. Frazier,

Check No. **31** *on Reply Card*

Chemical Cleaning of Equipment

Cut Maintenance Costs with Dowell Service; an eight page bulletin giving case histories and explaining the use of chemicals in the cleaning of boilers, condensers, filters, heat exchangers, and the like. Dowell, Inc.

Check No. **32** *on Reply Card*

Entrainment Separators

Metex Mist Eliminators, Bulletin MET-51-D; describes and illustrates action of woven wire mesh material useful as an entrainment separator in vacuum towers, fractionators, knock-out drums, and the like. Metal Textile Corp.

Check No. **33** *on Reply Card*

Alloy Reference Chart

Cooper Alloy 1950 *Reference Chart;* six-page folder containing comprehensive analysis of stainless, corrosion, and heat resistant alloy castings, giving designations—Cooper, Alloy Castings, Institute, AISI, SAE, ASTM, and others, applications, and properties. Cooper Alloy Foundry Co.

Check No. **34** *on Reply Card*

Chlorine Dispensing Equipment

Rato-Chlor Chlorine Dispensers, Catalog 61; eight pages describing line of dry-vacuum system units for metering, controlling, and dispensing chlorine, in capacities from one lb. to 1200 lbs./day, with automatic safety shutdown. Fischer & Porter Co.

Check No. **35** *on Reply Card*

Steel Shaft Engineering Data

Useful Data for Determining Stresses, Torques, Bending Moments, and Deflections in Steel Shafts, Bulletin G-7; 20 pages containing formulae, curves, and tables to assist designers in work with round, square, hollow, keyway, and stepped shafts, in sizes up to 12 in. in the solid and 21 in. in the stepped type. De Laval Steam Turbine Co.

Check No. **36** *on Reply Card*

Water Jet Eductors

SK Water Jet Eductors, Bulletin 2M; 36-page booklet including descriptions, detail line drawings, dimensions, specifications, and prices on line of water jet eductors useful in pumping and mixing in oil treating, introducing anti-knock and coloring dyes into gasolines, continuous blending, and treating of oil products, etc. Schutte and Koerting Co.

Check No. **37** *on Reply Card*

Controlled Solids Centrifuge

Sharples DV-2 Controlled Solids Discharge Centrifuge, Bulletin 1243; describes a new centrifuge employing the stratification principle of high separating efficiency combined with high capacity, and developing a force 6200 times that of gravity. The Sharples Corp.

Check No. **38** *on Reply Card*

A SURE CURE FOR "HOT PIPES"

"Hot Pipes" are heat-carrying lines with inadequate or no insulation. They allow BTU's to lay down on their job and to waste fuel.

But they can be cured. Fuel-saving CAREY Industrial Insulation keeps BTU's working, cuts production time, improves employee morale.

—and now—a new improved insulation . . .

CAREY TEMPCHEK

for temperatures up to 1500° F—with a low K-factor, rugged strength, excellent "Handleability"—

— a combination of outstanding qualities

Put BTU's to work. Call your Carey representative today — a trained expert, eager to serve you.

CAREY Makes The Complete Line!

85% Magnesia—Industrial Rock Wool—Asbestos—Pipe Coverings—Sheets—Blocks—Batts—Papers—Air-Cell

For free copy of "Heat Insulation for Industry," write Dept. PP-3. The Philip Carey Mfg. Co., Cincinnati 15, Ohio. In Canada: 1557 MacKay Street, Montreal 25, P. Q.

A PRODUCT OF THE HOUSE OF Carey

[*To obtain more data on advertised products see page* 296]

a 60 MILLION BTU installation in WEST TEXAS

a 71 MILLION BTU installation in NEW JERSEY

PETRO-CHEM
ISO-FLOW FURNACES
UNLIMITED

SIZE

CAPACITY

DUTY

a 65 MILLION BTU installation in the TEXAS PANHANDLE

a 55 MILLION BTU installation in LOUISIANA

PETR CHEM

ISO-FLOW FURNACES

UNLIMITED IN SIZE . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INCORPORATED

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Fluid Separators

Peerless Line Separators, Bulletin 101, covers operation and application of a non-centrifugal type separator with low pressure drop, large scrubbing area, and high efficiency for such jobs as separation of steam, ammonia, air lines, gas well, interstage, process vapor line, and lubricating oil. Peerless Mfg. Co.

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Radioactive Isotopes

Radioisotopes . . . A Survey: a general survey of the tracer and control work being done with radioisotopes in such industrial uses as development of refining catalysts, tagging and following hydrocarbons through various processes in the laboratory, etc. The Kellex Corp.

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Swivel Joint Catalog, Prices

Chiksan Catalog No. 50 illustrates and describes over 500 types and sizes of ball-bearing swivel joints, ranging from $\frac{3}{8}$ to 12-in., —25 to 600° F., and vacuum to 15,000 psi.; includes prices. Chiksan Co.

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Liquid Level Instruments

Levelimeter Instruments, Catalog 75; a 24-page booklet covering instruments that indicate, measure, and control liquid level and inter-face level; including magnetic tape-and-drum, electronically transmitting, ball-float, pneumatic and differential pressure units, V-notch weir and Parshall flume flowmeter instruments, and chemical service sight glasses. Fischer & Porter Co.

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Valves for Asphalts, Heavy Crudes

Corrosion-Resistant Valves, Technical Information Bulletin No. 3; describes jacketed valves and fittings in stainless steel and other alloys, with gaskets and seals of tetrafluorethylene; recommended for asphalt, heavy crude oils, petroleum residues, waxes, fatty acids, phthalic anhydride, and other materials. Alloy Steel Products Co., Inc.

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Strainer Data Are Revised

Yarway Fine Screen Strainers, Bulletin S-202: a revised publication on strainers ranging from $\frac{1}{4}$ to 3 in. size, including tables giving pressures, temperatures, and screen data that were not in the original issue. Yarnall-Waring Co.

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For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 297. Just check the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

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PETROLEUM SERVICE DIVISION

Personals

Walter Samans, mechanical and administrative engineer with Sun Oil Co., has announced the opening of his own consulting engineering practice on unfired pressure vessels and tanks, with offices located at 1616 Walnut St. in Philadelphia.

Mr. Samans

Mr. Samans was born in Goes, Holland, in 1882, and came to this country when he was nine years old. He received his B. S. in mechanical engineering from the University of Pennsylvania in 1905, and took a job with the Atlantic Refining Co. as design engineer and field construction supervisor. The following year he left Atlantic and joined Bessemer & Lake Erie Railroad Co. as assistant engineer to the chief engineer on bridges, buildings and miscellaneous structures.

Ten years later he was back in the refining industry—again with Atlantic, as assistant chief engineer on refinery design and construction. In 1921 he was made chief engineer for Atlantic, and held that post until 1937, when he joined Sun as a mechanical and administrative engineer.

Mr. Samans is a registered professional engineer in the state of Pennsylvania, and is a member of many technical societies, including the American Society of Mechanical Engineers, American Welding Society, and American Society of Civil Engineers. He has been active in API committee work since 1926, and, to list only a few of his responsibilities, was chairman of the Refinery Corrosion Committee from 1931 to 1936, chairman of the Unfired Pressure Vessel subcommittee from 1930 to date, national vice-chairman of the Committee on the Standardization of Tanks for Oil Storage from 1928 to date, and chairman of the Joint API-ASME Committee on Unfired Pressure Vessels from 1934 to date.

* * *

Stanolind Oil and Gas Co. has announced the transfer of a number of its employes to the new Stanolind chemical plant at Brownsville, Texas. The plant will recover chemical by-products from the new synthetic liquid fuels plant of Carthage Hydrocol, soon to start operation at Brownsville.

John G. Munson, who was field project engineer during construction of Stanolind's chemical plant, has been named assistant plant superintendent. Since joining Stanolind in 1947, he has been continuously associated with the engineering and construction of the Brownsville plant.

George R. Ayton, formerly technical group leader in the synthesis pilot plant at the Stanolind Tulsa research laboratory, will supervise the chemical operations section at Brownsville.

Joe C. Weaver, Jr., will be chemical process supervisor at the plant. He has been with Stanolind since 1947 and was a senior chemical engineer at the Tulsa research laboratory before being transferred.

Lloyd Christensen will supervise chemical plant laboratory operations. Before joining Stanolind in 1944, he was a chemistry and physics instructor at Oklahoma A&M College.

George C. Merrick, who was industrial relations supervisor for Stanolind's Central division, will be industrial relations supervisor for the chemical plant.

May A. Meek, formerly senior accountant at the Tulsa general office, will head the plant accounting section.

Raymond S. Tolson has been appointed plant protection supervisor, in charge of safety and plant protection problems. He joined Stanolind in 1948 as a mechanical engineer, and has been at Brownsville during the construction phase of the chemical plant.

* * *

Eric R. Kent of the research and development department, Socony-Vacuum Laboratories, Paulsboro, N. J., has been selected to receive the company's 1950 incentive fellowship award for advanced study for a doctor's degree. One recipient is selected each year, and under the terms of the award, full salary will be continued during the period necessary to earn the degree (not to exceed three years).

Mr. Kent

Mr. Kent was born in Vienna, Austria, and came to this country in 1938 in search of higher education and a career. After attending day and evening classes in the School of Technology of the College of the City of New York, he obtained the degree of bachelor of chemical engineering in June, 1944, became a U. S. citizen, married, and joined the U. S. Navy—all within one week.

His master's degree in chemical engineering was obtained at the University of Michigan in 1947, and shortly thereafter he joined the Socony-Vacuum laboratories, where he was assigned to the Process Development Division. He is the author of several pending patents on methods of wax purification. His graduate study will be concentrated in the field of hydrocarbon separation and recovery.

* * *

Edward J. Nopper is assistant chief engineer for Sun Oil Co.'s manufacturing department, after serving as chief electrical engineer for 14 years. A graduate of Baltimore Polytechnic Institute and Bliss Electrical School of Maryland, he joined the Susquehanna Pipe Line Co., Sun Oil affiliate, as a station engineer in 1932 and was transferred to Sun's manufacturing department as an electrical engineer in 1935. He is co-inventor of patented electrical systems and controls for the motor operated valves in Houdry fixed bed catalytic cracking units and also devised the 900-point cycle timer of these units.

Mr. Nopper

* * *

C. E. Noll, W. B. Shirk and **C. J. Livingstone** have been appointed directors of Gulf Oil Corp.'s recently organized Product Development and Product Engineering program, according to **H. P. Hobart,** vice president who heads the new division.

Mr. Noll, director of automotive products engineering, will be concerned with proper application of the firm's products to automotive equipment. He came with Gulf in 1924, and has recently been serving as manager of lubricating sales, automotive division.

Mr. Shirk, director of industrial products engineering, will supervise application of fuels and lubricants in prime movers and industrial plants. With the firm since 1932, he formerly was chief industrial lubrication engineer for lubricating sales.

Mr. Livingstone, director of product development, will be responsible for maintaining maximum quality of all products, such as gasoline, fuel oil, and lubricating oils. Mr. Livingstone just recently rejoined the company. He initially came with Gulf in 1939, and, prior to his recent reappointment, was assistant to the executive vice-president of the Gulf Research & Development Co.

Harry Sanford Brown, president and chairman of the board of Foster Wheeler Corp., died suddenly Feb. 18 of a heart ailment.

* * *

B. Bynum Turner has been named general manager of manufacturing to assume charge of Ethyl Corp.'s activities in Baton Rouge, La., home of the company's antiknock manufacturing plant. He relieves **John H. Schaefer**, vice president and director, who is returning to New York to direct all manufacturing operations from Ethyl headquarters. For the past two years, Mr. Turner has been co-ordinator of the $40 million plant expansion program, now completed.

* * *

Board of directors of the Asphalt Institute has elected **Bernard E. Gray** president of the institute and **Ingram Grayson** chairman of the executive committee. Other members of the executive committee are: **N. H. Angell**, Stancal Asphalt & Bitumuls Co.; **J. N. Byrd**, Mexican Petroleum Corp.; **P. C. Doyle**, Standard Oil Co. (Ohio); **H. B. Pullar**, Berry Asphalt Co.; **R. S. Ketcham**, Cal-Tex Refining Co.; and **Harold R. Pauley**, The Petrol Corp.

* * *

Cornelius J. Gaffney, foreman of cracking units at the Bayonne, N. J., refinery of Tide Water Associated Oil Co. and an employe of that company for 34 years, died suddenly on January 29 at his Bayonne home. Mr. Gaffney started working with Tide Water in 1915, and was cracking foreman since 1928.

MEETINGS . . . for the Oil Man

MARCH

22, Commercial Chemical Development Assn., Annual Meeting, Roosevelt Hotel, New York.

26-30, American Chemical Society, 117th National Meeting (divided), Houston.

27-29, Western Petroleum Refiners Assn., 38th Annual Meeting, Plaza Hotel, San Antonio.

28-31, Greater New York Safety Council, 20th Annual Safety Convention and Exposition, Hotel Statler and Hotel Governor Clinton, New York.

APRIL

4-7, National Assn. of Corrosion Engineers, Jefferson Hotel, St. Louis, Mo.

9-13, American Chemical Society, 117th National Meeting (divided), Philadelphia.

10-12, American Society of Lubrication Engineers, 5th Annual Convention and 2nd Annual Lubrication Exhibit, Hotel Statler, Detroit.

10-14, American Society of Mechanical Engineers, Hotel Statler, Washington.

12-14, National Petroleum Assn., Semi-Annual Meeting, Hotel Cleveland, Cleveland.

16-20, American Chemical Society, 117th National Meeting (divided), Detroit.

17-19, Society of Automotive Engineers, Aeronautic and Aircraft Engineering Display, Statler Hotel, New York.

24-25, Industrial Accident Prevention Assn., Royal York Hotel, Toronto, Canada.

24-26, Natural Gasoline Assn. of America, 29th Annual Convention, Texas Hotel, Fort Worth.

24-26, American Society of Mechanical Engineers, Process Industries, William Penn Hotel, Pittsburgh.

24-27, American Management Assn., 19th National Packaging Exposition, Navy Pier, Chicago.

MAY

1-4, American Petroleum Institute, Refining Division, Annual Spring Meeting, Hotel Cleveland, Cleveland.

8-11, Liquefied Petroleum Gas Assn., Annual Convention and Trade Show, Palmer House, Chicago.

15-18, National Fire Protection Assn., Annual Meeting, Haddon Hall, Atlantic City.

15-18, American Petroleum Institute, Central Committees on Accident Prevention and Fire Protection, Mid-Year Meeting, Haddon Hall, Atlantic City.

28-31, American Institute of Chemical Engineers, Regional Meeting, New Ocean House, Swampscott, Mass.

JUNE

4-9, Society of Automotive Engineers, Summer Meeting, French Lick Springs Hotel, French Lick, Ind.

8-9, American Management Assn., Hotel Statler, New York.

12-16, American Society of Mechanical Engineers, Oil and Gas Power Division, Conference and Exhibit, Lord Baltimore Hotel, Baltimore.

12-16, American Institute of Electrical Engineers, Summer and Pacific General Meeting, Huntington Hotel, Pasadena.

15-16, Pennsylvania Grade Crude Oil Assn., Annual Meeting, Hotel William Penn, Pittsburgh.

19-23, American Society of Mechanical Engineers, Semi-Annual Meeting, Hotel Statler, St. Louis.

26-30, American Society for Testing Materials, 53rd Annual Meeting, 9th Exhibit of Testing Apparatus and Related Equipment, Chalfonte-Haddon Hall, Atlantic City.

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Government-Sponsored Research Gives $100,000,000 to Schools

A THREAT to the future progress of research in the scientific schools of the nation is seen by some educators in the large sums now being disbursed by the federal government for specific research projects. In the current academic year, some 200 institutions will receive more than $100,000,000 from this source. All industry in this same period will spend $25,000,000.

This is an increase for both the federal government and industry of 500% over the funds so spent in prewar years, the *New York Times* brings out in a report on a survey conducted of 60 colleges and universities. The federal money for the most part is concentrated in the larger schools and many institutions reported the bulk of their research is directly subsidized by the federal government.

The volume of federal funds now being poured into research work in the schools has brought the educators several new problems. They fear that the emphasis now being placed on applied research will detract from their work in fundamental research, which heretofore has played an important part in the curricula of most schools. The educators also see the likelihood that the concentration of funds in the large schools, or selected schools, will subordinate the role of the smaller schools in the field of research. The possibility is seen that, in the case of schools receiving large grants of federal funds, too much dependence on the continuance of the funds may mould the nature of the schools' research program; also that there may eventually follow attempts from Washington to direct the schools' policies.

The diversity of financial support of the schools has been the best guarantee that educators would be left free to choose and direct their research activities. Their endowments and grants have come from a great many institutions, individuals and industrial interests. The technological advancements that have been achieved are widely recognized and the results evidenced in the conduct of two wars. To impair freedom of research in the schools in any way would be to lessen our national security.

Pilot Plant vs. Demonstration Unit for Design Improvement

THE Bureau of Mines Synthetic Liquid Fuels branch has just issued a report describing the special equipment which was required for its Louisiana, Mo., coal hydrogenation plant. This is a 200 b/d demonstration unit, the estimated cost of which to date has been over $11,000,000. In the plant operating pressures up to 10,000 psi. are combined with temperatures up to 1000° F. The material processed under these conditions ranges from gases to mixtures of viscous liquids containing high percentages of abrasive solid particles.

Few items of standard refinery equipment could meet these operating conditions and much of it had to be specially designed and built, such as heavy-wall insulated converters for the hydrogenation reation, heaters, pumps for coal paste injection, and including even tubing, valves, flanges and fittings for high pressure service.

"During the construction and break-in period, many improvements in process and design were developed", reads the Bureau's report. "In addition, manufacturers gained considerable knowledge in high-pressure design and fabrication methods—a long step toward preparing them for conversions necessary in building full-scale equipment. The road toward an economically sound synthetic fuel industry must lead through the construction, operation and improvement of demonstration and commercial-size plants."

It is debatable if this last is a sound conclusion, as based on the experience of the oil companies in the development of new processes. Recent competent estimates are to the effect it will be at least 10 years before there will be any need for high cost commercial synthetic liquid fuel plants to supplement the manufacture of these fuels from petroleum. Over that period great economies in both process and plant equipment must be made before it will be commercially practicable to synthesize liquid fuels from coal to hydrogenation.

The necessary improvements in design and process can be worked out over a period of several years in small-scale, flexible pilot plants much more conveniently and at far less cost than in larger demonstration plants. The size even of the Louisiana 200 b/d unit and its cost discourages the work with redesigned equipment and methods required by a new process in the stage of development of that of making liquid fuels from coal.

It is likely that the oil companies, with their unsubsidized and competitive research laboratories, will contribute more in coming years to making economic the manufacture of liquid fuels from the most suitable raw materials than will the Mines Bureau with the millions of taxpayers' money it plans to continue to pour into the Louisiana unit and other plants in its program.

More Than a Conversational Topic

THE refiners and large suppliers of petroleum products have heretofore been in the category of those described by Mark Twain when he said "Everybody talks about the weather but no one does anything about it." The two factors of the rapidly growing consumption of heating oil and the unusually warm present and preceding winters have emphasized that weather is perhaps the most variable factor affecting heating oil demand. One authority has stated (see pg. 241) that temperatures and other unexplained seasonal variations may cause stock fluctuations of as much as 25,000,000 bbls.

These conditions are now inducing study by the large oil companies to see what can be done to offset the short-term effect on heating oil supply/demand of abnormal temperatures. A carefully thought out inventory program plus adequate tankage, so that small adjustments in inventories can be made over a long period, is suggested as a means for avoiding the large adjustment over a short period that often upsets the refinery manufacturing program. Another suggestion is that the API undertake to compile and make public the changes in secondary heating oil stocks, those in the smaller terminals, bulk stations and even consumers' tanks.

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